

State of Connecticut

REPORT

OF

The Connecticut Agricultural
Experiment Station

FOR THE YEAR 1905

PART IV

FIFTH REPORT OF THE STATE ENTOMOLOGIST

W. E. BRITTON, Ph.D.

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OF

CONNECTICUT

FOR THE YEAR 1905

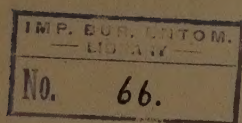
BY

W. E. BRITTON, PH.D.

State Entomologist

New Haven, Conn.

1906



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Figs. 1 and 7 from Bureau of Entomology, U. S. Department of Agriculture.

Figs. 2, 3, 4, 5 and 6 are from original photographs and drawings, cut on wood by Mr. R. M. Sherman.

Plate IV, a and f, are from photographs by H. A. Doty.

Plate III, d, is from a drawing; Plate III, c, VII and IX, a, are from photographs by W. E. Britton.

All other plates are from photographs by B. H. Walden.

PART IV.

FIFTH REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

Section 4387 of the General Statutes requires that the State Entomologist publish each year an account of the work and expenditures of his office. I transmit herewith my fifth annual report, and in its preparation have followed the custom of previous years, the period covered by the work being for the calendar year of 1905, except that the financial report covers the year ending September 30, 1905, and therefore corresponds with the State fiscal year.

Respectfully submitted,

W. E. BRITTON,

State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1904, TO SEPTEMBER 30TH, 1905.

Receipts.

From E. H. Jenkins, Treasurer	\$3,132.77
G. P. Clinton, for stamps	.59
T. Campbell, for mileage	1.44
Prof. S. A. Forbes, electrotypes	1.08
	\$3,135.88

Expenditures.

Field, office and laboratory assistance	\$1,371.47
Printing and illustrations	601.07
Postage	14.86
Stationery	9.42

Telephone and telegraph	\$ 1.90	
Express, freight and cartage	31.25	
Library	120.95	
Laboratory apparatus and supplies	327.71	
Spraying apparatus and supplies	54.99	
Office supplies	137.94	
Traveling expenses	251.91	
	\$2,923.47	
Balance, cash on hand	212.41	
		\$3,135.88

Memorandum—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts.

ORGANIZATION, EQUIPMENT, ETC.

Mr. B. H. Walden has continued as general assistant during the year. Most of the curatorial work of the collection has been done by him, as has also most of the photographic work. He has assisted in the work of spraying and other investigation and in the preparation of this report. Mr. Henry L. Viereck assisted in field and laboratory work from June 15 to September 15. A stenographer has been employed for half of each day to assist in the correspondence, cataloguing of specimens, and the preparation of manuscript. This work was done by Miss Anna Davis Clark during January, and by Miss Elizabeth B. Whittlesey for the remaining portion of the year.

The insect collection has been increased during the season, and several important additions have been made to the library.

A portion of the station greenhouse has been made available for the use of the entomological department as an insectary. While not ideal in its appointments, this house will serve the purpose of an insectary, and render it possible to study certain insects under conditions which can be kept more nearly under control than if out of doors.

EXHIBITS.

Entomological exhibits were made at the annual meeting of the Connecticut Pomological Society at Hartford in February, and at the meeting of the State Board of Agriculture at Willimantic in December.

LECTURES.

The State Entomologist has given ten addresses and lectures before granges, village improvement societies, farmers' institutes, etc., during the year. Four of these were illustrated with lantern slides.

CORRESPONDENCE.

1037 letters have been written during the year on matters pertaining to the work of the department.

74 packages have been sent out by mail and express.

PUBLICATIONS FROM THE ENTOMOLOGICAL DEPARTMENT.

Fourth Report of State Entomologist, March, 1905. 112 pp., 16 plates, 11 figures. (12,000 copies.)

Bulletin 151, June, 1905. "The Chief Injurious Scale Insects of Connecticut," by W. E. Britton. 16 pp., 17 figures. (12,000 copies.)

Bulletin of Immediate Information, No. 1, October, 1905, "Combating the San José Scale in 1905," by W. E. Britton and B. H. Walden. 4 pp. (1,000 copies.)

"The Lime and Sulphur Wash Without Boiling," *Rural New Yorker*, March 4, 1905, by W. E. Britton. 4 mss. pages.

*"The Fall Web Worm Partially Double Brooded in Connecticut," by W. E. Britton. Bulletin No. 52, Bureau of Entomology, United States Department of Agriculture, p. 42. 1 page.

*"Addition to Our Knowledge of the Cabinet Beetle (*Anthrenus verbasci* Linn)," by H. L. Viereck, Bulletin No. 52, Bureau of Entomology, United States Department of Agriculture, p. 48. 1 page.

"Mosquitoes and Their Relation to Public Health," by W. E. Britton. (Read at Conference of Health Officers, Hartford, December, 1904. Report of State Board of Health for 1905.)

"Some New or Little Known *Aleyrodidae* from Connecticut," (describing *Aleyrodes actaeae*, a new species), by W. E. Britton, *Entomological News*, Vol. 16 (March), 1905, p. 65. 2 pp., 1 plate.

"Description of the Larva of *Delphastus pusillus* Lec., with Notes on the habits of the Species," by W. E. Britton, *Canadian Entomologist*, Vol. 37 (May), 1905, p. 185. 2 pp., 1 figure.

"Trees Injured by White Lead and Oil," by W. E. Britton, *Rural New Yorker*, July 15, 1905. 3 mss. pages, 1 figure.

"Poultry Pests," by W. E. Britton, *Connecticut Farmer*, September 9, 1905.

* Read at meeting of American Association of Economic Entomologists, Philadelphia, Pa., December, 1904. Proceedings published by Bureau of Entomology.

EXAMINATION OF ORCHARDS, GARDENS, ETC.

Forty-eight orchards, gardens and greenhouses have been inspected by the State Entomologist or his assistant, mostly by request of the owners. In addition, the office has once been called upon to examine a swamp near a village to learn if mosquitoes were breeding therein.

NURSERY INSPECTION.

Thirty-five nurseries have been inspected during the year, and thirty-four certificates granted. The form of the certificate is the same as has been issued for the past two years, and is reproduced in the third report for 1903, p. 206. The insect pest law regarding nursery inspection also remains unchanged, and is not reproduced in this report, but may be found on p. 200 of the report for 1903.

In general, as regards freedom from pests, the nurseries were found to be in better shape than in 1904. One or two exceptions showed negligence and lack of care, and a drastic cleaning up of these was required.

The nursery firms receiving certificates in 1905 were as follows:

LIST OF NURSERY FIRMS RECEIVING CERTIFICATES IN 1905.

Name of Firm.	Location.	Inspection Finished.	Certificate Number.
Allen, Chas. I.	Terryville	Nov. 1,	204
Atwater, C. W.	Collinsville	Sept. 25,	179
Barnes Bros. Nursery Co.	Yalesville	Oct. 12,	192
Beers, S. Perry	Greenfield Hill ..	Oct. 3,	186
Bowditch, J. H.	Pomfret Center ..	Oct. 20,	199
Bridgeport Nursery Co.	Bridgeport	Nov. 10,	207
Burr & Co., C. R.	Manchester	Sept. 25,	180
Comstock & Lyon	Norwalk	Sept. 26,	181
Conine, F. E.	Stratford	Sept. 26,	182
Conn. Agricultural College	Storrs	Oct. 26,	201
Conway, W. B.	New Haven	Nov. 9,	206
Dehn & Bertolf	Greenwich	Oct. 17,	196
East Rock Park Nursery	New Haven	Oct. 11,	191
Elizabeth Park Nursery	Hartford	Sept. 22,	178
Elm City Nursery Co.	New Haven	Sept. 8,	174
Gardner's Nurseries	Cromwell	Sept. 29,	183
Gurney & Co., H. H.	New Canaan	Sept. 21,	177
Hale, J. H.	So. Glastonbury ..	Oct. 12,	193
Holcomb, Irving	Granby	Oct. 3,	185

Name of Firm.	Location.	Inspection Finished.	Certificate Number.
Hoyt's Sons Co., Stephen.....	New Canaan.....	Sept. 21,	176
Hunt & Co., W. W.	Hartford.....	Oct. 4,	187
Jewell, Harvey.....	Cromwell.....	Sept. 29,	184
Kellner, H. H.	Danbury.....	Oct. 18,	197
Kelsey & Sons, David S.	West Hartford...	Nov. 22,	208
Keney Park Nursery.....	Hartford.....	Oct. 28,	202
Norton, A. F.	New Britain.....	Nov. 1,	203
Pierson, A. N.	Cromwell.....	Sept. 18,	175
Platt Co., The Frank S.	New Haven.....	Sept. 27,	200
Ruedlinger, C. N.	Hartford.....	Nov. 4,	205
Ryther, O. E.	Norwich.....	Oct. 19,	198
Scott, J. W.	Hartford.....	Oct. 4,	188
Vidbourne & Co., J.	Hartford.....	Oct. 16,	194
Woodruff, C. V.	Orange.....	Oct. 7,	189
Woodruff & Sons, S. D.	Orange.....	Oct. 7,	190

CHIEF LINES OF INVESTIGATION.

Scale-Insect Studies.—As in former years, considerable attention has been given to the destruction of the San José scale in Connecticut orchards by spraying, and several experiments were conducted. Over 6,000 trees, consisting of apple, pear, plum, but mostly of peach, were sprayed early in spring with various mixtures of lime and sulphur. The kerosene-limoid mixture was given a trial in comparison with these mixtures, but was not very satisfactory. A full account of these experiments is given in this report. Fumigation tests in destroying this insect on nursery stock are now in progress. We find that the scale breeds continuously throughout the winter on fruit trees in greenhouses.

The other kinds of scale-insects of Connecticut have been collected and studied, and a number of the most serious pests among them were figured and described in Bulletin No. 151.

Tobacco Insects.—The insects attacking tobacco in Connecticut have received attention from this office for three years. During 1905, however, more progress was made than has been possible before. Insects were collected from fields in different parts of the state, and their effect on the plants studied. A large number of tobacco worms were gathered, for the purpose of rearing adults, some of which emerged in the fall. As this investigation has not been finished, we have considered it best to withhold the publication of the results until

the work of at least one more year can be available to settle certain questions. Tobacco plants everywhere were severely attacked by cutworms, and a note regarding treatment recommended against this pest will be found on p. 260.

Mosquito Investigations.—The mosquito investigations described in the last report (1904, p. 253) were continued briefly during 1905. On account of a drought during May and another in July, there was much less stagnant water, and therefore less mosquito breeding, than in 1904. The territory about several inland towns and cities, including Farmington, New Britain and Rockville, was examined, and the results are included in this report. Upon request, a swamp area near the cemetery at Milford was examined, and a report made to the health officer of that town. See page 224.

Insects which Pollinate Fruit Blossoms.—Extensive collections have been made of the insects which visit the flowers of fruit trees and plants during the past two seasons. A complete list of these has been prepared, and is published on page 207 of this report, with the addition of notes regarding the relative value of the various species in carrying pollen.

The Connecticut Insect Fauna.—As mentioned in last year's report, a study of the insect fauna of Connecticut is being made, and this work has been continued through the season. The northeastern portion of the state was visited, Mr. Viereck making collections at Rockville, West Thompson and Putnam in July, and Mr. Britton at Stafford Springs the latter part of August. Torrington and Colebrook were also visited by Messrs. Britton and Viereck, and important collections were made. Mr. Walden collected extensively at Scotland in August, and much collecting was done on short trips around New Haven. Lists of Connecticut insects will eventually be published. Such lists of two orders (Orthoptera and Hymenoptera) are now being prepared under the direction of the State Entomologist, and will be published by the Geological and Natural History Survey of the State. Lists of other orders will be undertaken later. These lists are based upon the specimens in the station collection, though of course additional records are obtained wherever possible.

Tests of Insecticides.—In the course of the season there were opportunities for experiment in the destruction of insects by

means of various insecticides, and many such tests were made. Arsenate of lead has been used in a number of cases where an arsenical poison was needed, and has been found satisfactory.

General Observation on Injurious and Beneficial Insects.—Observation and records are constantly being made of insects causing injury to plants or animals, especially those forms which attack cultivated crops and shade trees. Parasites have been reared from many of the collected specimens.

ENTOMOLOGICAL FEATURES OF 1905.

Like the season of 1904, the preceding winter was unusually severe, and certain kinds of insect life were destroyed by it. About 35 per cent. of the over-wintering San José scales were killed. During the latter part of the season, however, the scales multiplied rapidly, and many trees were found thoroughly infested when not known to be infested early in the season.

Cutworms were extremely abundant, and did more damage than in 1904 or for several years. Corn, tobacco and other field crops were severely injured by them. Sweet corn, which is extensively grown for seed, had to be replanted in many cases. Tobacco had to be reset, in some instances several times. Vegetables of nearly all kinds in gardens and on truck farms were greatly injured by the attacks of cutworms. It seems strange that the large growers do not practice using the poisoned bait of bran mash which has so often been found successful.

The onion maggot, though still doing some damage, was much less injurious than in 1904. The cabbage maggot, however, did much damage in various parts of the state.

Woolly aphid is becoming more and more prevalent in young orchards and on nursery trees. On the roots, this insect is difficult to control, and some orchardists are now putting tobacco dust around the young trees when planting them. The apple aphid, *Aphis pomi* DeG., was not very abundant.

The elm leaf beetle still continues to decrease, and very little damage resulted from its attack on New Haven trees in 1905. Many of the elm trees were defoliated, but from a different cause. The white-marked tussock moth was more abundant in Connecticut than for ten years. In New Haven, trees in the eastern portion of the city were injured more than else-

where, and the insect, was observed to be common in Hartford, Bridgeport and Norwalk.

The woolly maple leaf scale is beginning to attract attention as a pest of the sugar maple and specimens were sent in from three localities. This scale and the white-marked tussock moth are treated more fully in another part of this report.

The fall web worm was present everywhere, and denuded many trees in August and September.

The potato beetle was far more common than in 1903 or 1904.

COMBATING THE SAN JOSÉ SCALE IN 1905.

BY W. E. BRITTON AND B. H. WALDEN.

In 1905 about 6,000 fruit trees were sprayed in our experiments. These were in five different orchards, and were situated as follows:

Westville	150 pear trees.
Middletown	68 peach "
Westport	125 " "
West Haven	395 " "
Southington	5,271 peach and apple trees.
Total	6,009

SPRAY MIXTURES.

The spraying materials were chiefly lime and sulphur mixtures, and included the regular boiled mixture both with and without salt in comparison with three of the self-boiled mixtures, namely: lime, sulphur and sodium sulphide; lime, sulphur and caustic soda; lime, sulphur and sal soda. Kerosene-limoid mixture was also tested in competition with the lime and sulphur preparations. The mixtures were prepared after the formulas given below:

FORMULAS.

Mixture No. 1.	$\left\{ \begin{array}{l} 20 \text{ lbs. lime.} \\ 14 \text{ lbs. sulphur.} \\ 40 \text{ galls. water.} \end{array} \right\}$	$\left\{ \begin{array}{l} \text{Light sulphur flour added dry to} \\ \text{the slaking lime. Boiled 45-60 min-} \\ \text{utes.} \end{array} \right\}$
Mixture No. 2.	$\left\{ \begin{array}{l} 20 \text{ lbs. lime.} \\ 14 \text{ lbs. sulphur.} \\ 10 \text{ lbs. salt.} \\ 40 \text{ galls. water.} \end{array} \right\}$	$\left\{ \begin{array}{l} \text{Light sulphur flour and salt added} \\ \text{to the slaking lime. Boiled 45-60} \\ \text{minutes.} \end{array} \right\}$

Mixture No. 3.	$\left\{ \begin{array}{l} 20 \text{ lbs. lime.} \\ 10 \text{ lbs. sulphur.} \\ 10 \text{ lbs. sodium sulphide.} \\ 40 \text{ galls. water.} \end{array} \right.$	Best whitewash or finishing lime started slaking, sulphur added. When at greatest heat sulphide was added with constant stirring.
Mixture No. 4.	$\left\{ \begin{array}{l} 20 \text{ lbs. lime.} \\ 14 \text{ lbs. sulphur.} \\ 5 \text{ lbs. caustic soda.} \\ 40 \text{ galls. water.} \end{array} \right.$	Best whitewash or finishing lime started slaking with hot water, and sulphur added. When at greatest heat, caustic soda was added with constant stirring.
Mixture No. 5.	$\left\{ \begin{array}{l} 20 \text{ lbs. lime.} \\ 14 \text{ lbs. sulphur.} \\ 10 \text{ lbs. sal soda.} \\ 40 \text{ galls. water.} \end{array} \right.$	Best whitewash or finishing lime started slaking with hot water, and sulphur added. When at greatest heat sal soda was added with constant stirring.
Mixture No. 6.	$\left\{ \begin{array}{l} 40 \text{ lbs. limoid.} \\ 10 \text{ galls. kerosene.} \\ 30 \text{ galls. water.} \end{array} \right.$	Kerosene absorbed by the limoid and stirred or churned violently to mix with the water.

As in previous tests, twigs were examined before treatment to ascertain how many scales had been winter-killed. By this method it is possible to represent more accurately the values of the different preparations as scale destroyers. This examination showed that on the average 35 per cent. of the wintering scales had been killed.

Twigs were cut late in June, just before the young began to appear, and a second count was made to determine the number and proportion killed by the spraying. A general examination of the orchards was made about October 1st.

To illustrate. If in the early spring count, out of 1,000 wintering scales examined 350 are found dead, we count 35 per cent. as winter-killed, leaving, out of every 1000 scales, 650 alive. If in June we find 25 alive out of every 1,000 scales counted, we assume that the spray has killed 625 out of every 650, which is equivalent to 96.1 per cent.

WESTVILLE EXPERIMENTS.

The pear trees treated are the same as described in the account of our spraying experiments of last year (see Bulletin 146, p. 11), and are owned by A. N. Farnham. They had been considerably injured by scale before any treatment was given them, so that while not now badly infested, many are unthrifty, and are not making a satisfactory growth. The spraying was done on March 28th, with a "Hardie" No. 6 pump, only self-boiled mixtures being used. Eighty trees were sprayed with lime, sulphur and caustic soda (formula

TABLE I.—EXPERIMENTS AT WESTVILLE.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.
					Winter killed.	Killed by treatment.	Alive after treatment.	
4-31	Pear	80	Medium sized trees. Not vigorous. Moderately infested.	Formula No. 4— 20 lbs. lime. 14 lbs. sulphur. 5 lbs. caustic soda. 40 galls. water. (Self-boiled.)	34	61.5	4.5	93.2
					35	63.5	2.6	96
32-49	Pear	70	"	Formula No. 3— 20 lbs. lime. 10 lbs. sulphur. 10 lbs. sodium sulphide. 40 galls. water. (Self-boiled.)				
		150						

No. 4). The remaining seventy trees were sprayed with lime, sulphur and sodium sulphide (formula No. 3).

There was very little difference in the adhesive quality of the mixtures, and when the twigs were cut for the second examination in June, lime could be seen on the under sides of the branches and in the more protected places. Table I, page 198, shows the results. Formula No. 3 here gave a greater percentage efficiency than formula No. 4. When examined on October 2d, the trees were in fair shape, and about half had made good growth though many were not vigorous on account of previous injury. Living scales were found on most of the trees, but were most abundant on the outside rows, and reinfestation may have been responsible for it. Some trees bore fruit, and this was practically free from scale. A few trees only were infested with psylla.

WESTPORT EXPERIMENTS.

An orchard of small peach trees near the railroad, owned by Mr. S. B. Wakeman, was found during the winter to be moderately infested with scale. Plans were made to spray it, using both lime and sulphur and the kerosene-limoid mixtures. A portion of the trees were sprayed with the latter mixture, but on account of bad weather it was impossible to finish the work until the buds were open and too late to apply the lime and sulphur treatment. Table II, page 200, shows that over seven per cent. of the scales survived the treatment.

An examination of this orchard was made on October 17th, and though plenty of living scales could be found on most of the trees, there were few trees badly infested, and abundance of dead scales showed that the treatment was fairly satisfactory. As the other mixtures were not used in this orchard there is no basis for comparison.

EXPERIMENTS AT MIDDLETOWN.

These tests were made in a peach orchard of moderate size, owned by J. M. Hubbard & Son, and found during the winter to be infested with scale. The owners sprayed the entire orchard with the boiled lime and sulphur mixture. Sixty-eight trees were included in our tests, twenty-one being treated

TABLE II.—EXPERIMENTS AT MIDDLETOWN AND WESTPORT.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.
					Winter killed.	Killed by treatment.	Alive after treatment.	
50-54	Peach	21	Medium sized bearing trees. Some had been injured by scale.	Formula No. 1— $\left\{ \begin{array}{l} 20 \text{ lbs. lime.} \\ 14 \text{ lbs. sulphur.} \\ 40 \text{ galls. water.} \end{array} \right.$ (Boiled.)	41	54.5	4.6	92.3
55-62	Peach	47 — 68	"	Formula No. 2— $\left\{ \begin{array}{l} 20 \text{ lbs. lime.} \\ 14 \text{ lbs. sulphur.} \\ 10 \text{ lbs. salt.} \\ 40 \text{ galls. water.} \end{array} \right.$ (Boiled.)	44	51.7	4.3	92.3
150-163	Peach	125*	Mostly small bearing trees. Some badly infested.	Formula No. 6— $\left\{ \begin{array}{l} 40 \text{ lbs. limoid.} \\ 10 \text{ galls. kerosene.} \\ 30 \text{ galls. water.} \end{array} \right.$	35	57.9	7.1	89

* Westport.

with lime and sulphur, and forty-seven being sprayed with lime, sulphur and salt. The mixture was cooked in the orchard by steam from a "Kinney Safe" engine, and applied with an "Eclipse" pump fitted with two lines of hose and double Vermorel nozzles. The results shown in Table II, page 200, indicate that the salt did not affect the mixture as a scale-destroyer.

When the twigs were cut in June, no difference was found in the sticking qualities of the two mixtures.

The final examination, made on October 5th, showed that the scale was well controlled throughout the entire orchard and but few living scales were found. Traces of the mixture still remained on many of the trees.

EXPERIMENTS AT WEST HAVEN.

These experiments were carried on in the peach orchard of Mr. N. S. Platt, on rather large trees of seven or eight years' planting. The orchard was more or less infested throughout, and some trees had been killed by scale.

The spray liquid was applied with a "Hardie" No. 6 pump mounted upon a drag. In these tests limoid and kerosene (formula No. 6) was tried in comparison with the self-boiled mixtures. A majority of the trees were sprayed with formula No. 3, formula No. 4 was used on more than a hundred trees, and a number of trees were left unsprayed.

Table III, page 202, shows formula No. 4 to have been rather more efficient than formula No. 3 in this orchard. Limoid and kerosene (formula No. 6) was less efficient than either of the others.

The final examination was made on October 2d, when the benefits of spraying were marked. Unsprayed trees were literally covered with living scales, while adjacent sprayed ones were nearly clean. Of course a few living ones could be seen on most of the trees, but they were more numerous on the trees treated with limoid and kerosene (formula No. 6) than on the other sprayed trees, though all were about equally situated as regards liability to reinfestation.

This last examination confirms the results expressed in figures in Table III, regarding the effectiveness of the mixtures. Trees treated with lime, sulphur and caustic soda (formula No. 4) and those sprayed with lime, sulphur and

TABLE III.—EXPERIMENTS AT WEST HAVEN.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.
					Winter killed.	Killed by treatment.	Alive after treatment.	
64-88 214-220	Peach	213	Good sized bearing trees. Some had been injured by scale.	Formula No. 3— 20 lbs. lime. 10 lbs. sulphur. 10 lbs. sodium sulphide. 40 galls. water. (Self-boiled.)	34	61.0	4.9	92.4
89-92 200-207	Peach	132	"	Formula No. 4— 20 lbs. lime. 14 lbs. sulphur. 5 lbs. caustic soda. 40 galls. water. (Self-boiled.)	35	60.9	4.1	93.7
208-213	Peach	50	"	Formula No. 6— 40 lbs. limoid. 10 galls. kerosene. 30 galls. water.	27	65.8	7.2	90.1
		395						

sodium sulphide (formula No. 3) were all remarkably free from living scales, though plenty of dead ones were found. A heavy rain the following night washed off some of the lime, sulphur and caustic soda (formula No 4), but did not greatly diminish its insecticidal value.

SOUTHINGTON EXPERIMENTS.

These experiments were conducted in the orchards of E. Rogers and J. H. Merriman in the Shuttle Meadow region of Southington. Some trees were badly infested, but most of them were uninjured. For the most part the boiled lime and sulphur mixture (formula No. 1) was used. One hundred and fifty trees were sprayed with formula No. 2 (containing salt), 240 with lime, sulphur and sodium sulphide mixture (formula No 3), 80 with lime, sulphur and sal soda (formula No. 5), and 85 with limoid and kerosene (formula No. 6). "Spra-motor" pumps fitted with double lines of hose and mounted on wagons were used in this orchard. Both "Spra-motor" and double "Vermorel" nozzles were employed. The mixture was boiled near the orchard in open barrels with steam from a "Kinney Safe" engine. It is always advisable where possible to place the cooking plant near a water supply. Mr. Rogers here used an ejector to draw water from a well, as is shown on plate I, b, and this was found to be a satisfactory arrangement. A neighbor, Mr. W. N. Dunham, sprayed several hundred trees, and for boiling the mixture used a small boiler of stationary pattern, though light and transportable. This boiler was not expensive, could be carried about in an express wagon, and was found satisfactory. His outfit is shown on plate I, a.

Table IV, page 204, shows the results. The highest percentage efficiency of treatment was given by the lime, sulphur and sodium sulphide mixture (formula No. 3); the lowest, by the kerosene and limoid mixture (formula No. 6).

When examined in June, the kerosene and limoid apparently had not injured the trees, and all sprayed trees were in good condition. When finally examined on October 9th, few living scales could be found on the sprayed trees in Mr. Rogers' peach orchard, though there were plenty of dead ones. Occasionally we noticed a small twig or branch with an abun-

TABLE IV.—EXPERIMENTS AT SOUTHLINGTON.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.
					Winter killed.	Killed by treatment.	Alive after treatment.	
93-98	Peach	4606	Medium sized trees not badly infested.	Formula No. 1— 20 lbs. lime. 14 lbs. sulphur. 40 galls. water. (Boiled.)	35	60.0	4.9	92.3
	Apple	110	Medium sized trees. Some badly infested.	Formula No. 2— 20 lbs. lime. 14 lbs. sulphur. 10 lbs. salt. 40 galls. water. (Boiled.)				
99-103	Peach	150	Bearing trees of medium size. Moderately infested.	Formula No. 3— 20 lbs. lime. 10 lbs. sulphur. 10 lbs. sodium sulphide. 40 galls. water. (Self-boiled.)	39	56.5	4.5	92.6
	Peach	240	Small bearing trees. A few badly infested.	Formula No. 5— 20 lbs. lime. 14 lbs. sulphur. 10 lbs. sal soda. 40 galls. water. (Self-boiled.)	40	57.8	2.2	96.3
115-121	Peach	80	Small bearing trees. A few badly infested.	Formula No. 6— 40 lbs. limoid. 10 galls. kerosene. 30 galls. water.	39	55.7	5.3	91.2
	Peach	85	Large trees, badly infested. Some killed by scale.		26	63.5	10.6	85.7
122-129		5271						

dance of living scales, while the remainder of the tree was nearly free from them. These branches in all probability had not been well coated with the spray. The presence of salt in the mixture made no difference in the appearance of sprayed trees. Some medium-sized apple trees which were sprayed on a windy day were quite badly infested, but certain portions of the trees were also covered with dead scales, and the lack of thoroughness in spraying these trees doubtless accounts for their condition. Similar trees in Mr. Merriman's apple orchard were better sprayed, and are now comparatively free from scale. The young peach trees in the Merriman orchards are remarkably clean, and the October examination confirmed the figures obtained in June regarding the effectiveness of the self-boiled mixtures. Some large trees were sprayed with limoid and kerosene (25 per cent. kerosene) and the others with the boiled lime and sulphur mixture. Many of the former though thoroughly covered by the spray, and perfectly white after treatment, were found to be badly infested with living scales when examined in October. In adjoining rows, similar trees treated with lime and sulphur were comparatively free. This seems to indicate that (1) either the limoid and kerosene mixture was not as effective in killing the scales, or (2) that the scales more readily reëstablished themselves on trees sprayed with it.

The average percentage efficiency of each of these insecticides, for the localities where tested, may be found in Table V.

TABLE V.—PERCENTAGE EFFICIENCY OF INSECTICIDES.

FORMULA No.	Percentage of Efficiency of Insecticides at					Average for these localities.
	West-ville	Middle-town.	West-port.	West Haven.	South-ington.	
1. Lime and sulphur	----	92.3	----	---	92.3	92.3
2. Lime, sulphur and salt	----	92.3	----	----	92.0	92.5
3. Lime, sulphur and sodium sulphide	96.	----	----	92.4	96.3	94.9
4. Lime, sulphur and caustic soda	93.2	----	----	93.7	---	93.5
5. Lime, sulphur and sal soda	----	----	----	----	91.2	91.2
6. Limoid and kerosene	----	----	89.	90.1	85.7	88.3

COST OF THE DIFFERENT MIXTURES.

The boiled lime and sulphur mixture without salt is the cheapest of all so far as the cost of materials is concerned.

The operation of boiling of course increases the cost, but probably this does not exceed fifteen or twenty cents per barrel of forty gallons where the proper kind of an outfit is employed. For use on a few trees in the back yard, or even for spraying an orchard of 200 or 300 trees, one of the self-boiled mixtures will probably be the least expensive if there is no convenient outfit for boiling at hand.

In reckoning the cost of materials, lime is figured at \$2.00 per barrel of 300 lbs., sulphur at \$2.85 per C., hay salt at 60 cts. per C., caustic soda (74 per cent.) in 25 lb. pails at 6 cts. per lb., sal soda, 2 cts. per lb., sodium sulphide in 110 lb. drums at $3\frac{1}{2}$ cts., per lb., limoid at \$2.50 per bbl., and kerosene at 10 cts. per gallon; these being current prices for small quantities. In large lots the prices are considerably lower. The materials to make forty gallons or enough to fill a spray barrel of each of the various mixtures cost as follows:

Formula No. 1		\$.54
" No. 2		.60
" No. 3		.78
" No. 4		.84
" No. 5		.74
" No. 6		1.66

WHERE MATERIALS MAY BE PURCHASED.

Lime may be purchased from dealers in all parts of the State. Mortar lime can be used in making a boiled mixture, but generally there is, in it, much more sediment to clog strainers and nozzles; therefore we recommend the use of whitewash or finishing lime, and in preparing a self-boiled mixture mortar lime should never be used.

Sulphur and caustic soda may be obtained through any wholesale drug firm, or may be purchased direct from dealers in New York.

Limoid is hydrated lime, and can be purchased from the manufacturers, The Charles Warner Company, Wilmington, Del. Sodium sulphide is sold by the Roessler & Hasslacher Chemical Company, 100 William St., New York City, and sal soda, hay salt and kerosene may be obtained anywhere from local merchants.

For a detailed account of the methods of preparing the various mixtures, and description of spraying apparatus, etc., the reader is referred to Bulletin No. 146, or to the report of this station for 1904, page 240.

SUMMARY.

1. About 6000 peach, apple and pear trees in Westville, Middletown, Westport, West Haven and Southington were sprayed in the spring of 1905 to destroy the San José scale.

2. The insecticides used were the boiled mixtures of lime and sulphur; lime, sulphur and salt; the self-boiled mixtures of lime, sulphur and sodium sulphide; lime, sulphur and caustic soda; and the kerosene and limoid mixture (see formulas, p. 196).

3. In these tests the lime, sulphur and sodium sulphide mixture gave the highest percentage efficiency, and the kerosene and limoid the lowest, though the difference was not striking, and all of the mixtures employed must be considered as fairly effective scale destroyers. The beneficial effect (if any) of salt in the boiled mixture was scarcely perceptible.

4. The cost of the materials is least for the boiled mixtures, and we recommend those where steam can be obtained for the purpose. The cost of boiling, however, makes the price nearly equal to the cost of the self-boiled mixture. Boiled lime and sulphur mixture is probably cheapest for the large orchard, and one of the self-boiled mixtures will prove cheapest for the small orchard and garden. Though somewhat easier to prepare and apply, the cost of the kerosene and limoid will make it prohibitory on a large scale.

A summarized account of these experiments was printed as Bulletin No. 1 of Immediate Information, containing four pages, and mailed to the Connecticut members of the Pomological Society in October. Only 1,000 copies were printed.

INSECTS COLLECTED FROM THE FLOWERS OF
FRUIT TREES AND PLANTS.*

BY W. E. BRITTON AND HENRY L. VIERECK.

For many years horticulturists and entomologists have regarded the honey bee, *Apis mellifera* Linn., as the most important species of insect engaged in the pollination of the flowers of our fruit-bearing trees and shrubs. Benton states† that bees are the most abundant of the insects visiting the

* This paper as originally prepared was read before the meeting of the American Association of Economic Entomologists at Philadelphia, December 29 and 30, 1904, but was withdrawn from publication in the proceedings of that meeting, and has not until this time been published. The paper has been emended and rearranged, and contains important additions.

† Frank Benton, The Honey Bee, Bulletin I, Division of Entomology, p. 63.

fruit blossoms. In his study of the pollination of pear flowers ten years ago, Waite found about fifty different kinds of insects visiting pear blossoms, but that the common honey bee was "the most regular and important abundant visitor, and probably does more good than any other species."* In an address before the Georgia State Horticultural Society in 1903, Professor Wilmon Newell stated that "no insect so effectually accomplishes this distribution of pollen as the honey bee."† According to Müller also the honey bee is an abundant visitor of plum, pear, apple, currant and gooseberry flowers in Europe.‡

The importance of honey bees in pollinating fruit flowers has been pointed out by a great number of popular and technical writers, and we were somewhat surprised in looking over the results of a few minutes' collecting in the garden in 1904 to find that honey bees were exceedingly scarce in comparison with other species of *Hymenoptera*,—or in fact with other insects. Observations were therefore continued on some of our common fruit trees. No attempt is here made to give a complete list of the insect visitors of these plants. The lists represent only the insects taken from the flowers and in sweeping over them. The collecting was done mostly by the writers at odd moments during sunny forenoons on the grounds of the Experiment Station in New Haven. The dates of the collecting were from May 4th to May 14th, 1904, during which time currant, gooseberry, apple, pear, plum and cherry were in bloom; the insects from blackberry flowers were taken June 3d, 1904. During 1905 many specimens were taken from apple and quince flowers at Branford by Rev. H. W. Winkley, and the results are incorporated in this paper. The Branford specimens were collected from May 11th to May 22d. During this time Mr. B. H. Walden also collected insects on quince, cherry, peach, raspberry and strawberry at New Haven. The accompanying list contains the results of all these collections.

It is not known to the writers that bees are kept in the immediate vicinity of the Experiment Station; there are

* M. B. Waite, The Pollination of Pear Flowers, Bulletin V, Division of Vegetable Pathology, p. 79.

† Proceedings, 27th Annual Meeting, Georgia State Horticultural Society, 1903.

‡ H. Müller, The Fertilization of Flowers (Thompson's translation).

several hives less than two miles away. Wild honey bees are probably not very abundant so near the city. We should expect them to be much more abundant at Branford.

The writers desire to express their obligations to Mr. C. W. Johnson of Boston for determining the *Diptera*. The *Hymenoptera* have been identified by Mr. Viereck.

The species of plants collected from, together with the number of specimens and species of insects taken from each, is as follows:—

Plant.	No. of Insects.	No. of Species.
<i>Ribes oxyacanthoides</i> , American Gooseberry.....	883	72
" <i>rubrum</i> , Common Red Currant.....	123	59
" <i>nigrum</i> , Common Black Currant.....	154	23
<i>Prunus</i> sp. (probably a native species).....	39	15
" <i>triloba</i> , Japan Plum.....	405	44
" <i>avium</i> , Sweet Cherry.....	370	37
" <i>persica</i> , Peach	12	8
<i>Pyrus malus</i> , Common Apple.....	229	52
" <i>communis</i> , Common Pear.....	73	29
<i>Cydonia vulgaris</i> , Common Quince.....	77	30
<i>Rubus nigrobaccus</i> , Common High Bush Blackberry	18	8
" <i>strigosus</i> , Red Raspberry.....	22	13
<i>Fragaria virginiana</i> , Strawberry.....	11	6
Total	2,416	396

The following list shows the number of species in each order, so far as they could be determined, with the number of specimens of each species.

In the *Hymenoptera*, the sexes have been recorded separately, but workers or neuters are enumerated only in the column of totals. It will be seen that the females greatly predominate.

DIPTERA (Flies, mosquitoes).

	Specimens
<i>Ceratopogon fuscus</i> Coq.	10
<i>Rhamphomyia nana</i> Loew.	1
<i>Lonchoptera lutea</i> Panz.	20
" <i>riparia</i> Meig.	20
<i>Eristalis bastardi</i> Macq.	2
<i>Panzeria radicum</i> Fabr.	4
<i>Homalomyia scalaris</i> Fabr.	1
<i>Phorbia fusciceps</i> Zett.	3
<i>Fucellia fucorum</i> Fall.	2
<i>Scatophaga stercoraria</i> Linn.	6
<i>Chlorops assimilis</i> Macq.	8
<i>Elachiptera costata</i> Loew.	19
<i>Oscinis coxendix</i> Fitch.	3
" <i>sp.</i>	1
<i>Drosophila graminum</i> Fall.	1
" <i>sp.</i>	2
<i>Agromyza angulata</i> Loew.	2
<i>Desmometopa m-nigrum</i> Zett.	1
" <i>latipes</i> Meig.	1

Total, 19 species 107

COLEOPTERA (Beetles).

	Specimens
<i>Phyllotreta sinuata</i> Steph.	1
<i>Epitrix cucumeris</i> Harris.	2
<i>Diabrotica vittata</i> Fabr.	1
<i>Adalia bipunctata</i> Linn.	1

Total, 4 species 5

HEMIPTERA (Bugs, leaf-hoppers, etc.).

	Specimens
<i>Lygus pratensis</i> Linn.	4
Undetermined Tettigonid	1
" Jassid	6

Total, 3 species 11

Common Red Currant, *Ribes rubrum*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
<i>Dolerus aprilis</i> Nort.	1	1	2
<i>Apanteles sp.</i>	1	..	1
" "	..	1	1
<i>Sympratis ? sp.</i>	..	1	1
<i>Exochus semirufus</i> Cress.	1	..	1
Undetermined Tryphonid	..	..	1
<i>Ichneumon subcyaneus</i> Cress.	1	..	1
" <i>seminiger</i> Cress.	..	1	1
Undetermined Chalcidid	..	..	1
" "	..	..	1
<i>Crematogaster lineolata</i> Say.	..	..	1

HYMENOPTERA (Bees, wasps, ants)—*Cont'd.*

	Male	Female	Total No. Specimens
<i>Cryptocheilus conicus</i> Say.	1	..	1
<i>Colletes valida</i> Cress.	2	..	2
<i>Oxystoglossa similis</i> Robt.	..	1	1
<i>Halictus fasciatus</i> Nyl.	..	1	1
" (<i>Evylaeus</i>) <i>truncatus</i> Robt.	..	1	1
" (<i>Chloralictus</i>) <i>zephyrus</i> Sm.	..	7	7
" " <i>sp.</i>	..	13	13
" " <i>sparsus</i> Robt.	..	3	3
" " <i>n. sp.</i> ?	..	1	1
" " <i>n. sp.</i>	..	1	1
<i>Trachandrena crataegi</i> Robt.	3	..	3
" <i>forbesii</i> Robt.	1	..	1
" var.	1	1	2
<i>Andrena mandibularis</i> Robt.	..	1	1
" <i>nasoni</i> Robt.	3	1	4
" <i>vicina</i> Sm.	3	..	3
" <i>sp.</i>	1	..	1
Total, 28 species	19	35	58

DIPTERA (Flies, mosquitoes).

	Specimens
Undetermined Chironomid	1
<i>Sciara</i> <i>sp.</i>	1
<i>Rhamphomyia brevis</i> Loew.	1
<i>Pipiza albipilosa</i> Will.	1
" <i>femoralis</i> Loew.	1
<i>Melanostoma mellinum</i> Linn.	1
<i>Hyalomyodes triangulifera</i> Loew.	1
<i>Panzeria radicum</i> Fabr.	4
<i>Sarcophaga helioides</i> Town.	1
" <i>sp.</i>	1
" "	1
<i>Lucilia caesar</i> Linn.	1
<i>Phormia regina</i> Meig.	1
<i>Ophyra leucostoma</i> Wied.	1
<i>Anthomyia radicum</i> Linn.	3
<i>Phorbia cinerella</i> Fall.	1
" <i>fusciceps</i> Zett.	16
<i>Fucellia fucorum</i> Fall.	2
<i>Scatophaga stercoraria</i> Linn.	6
<i>Sepsis violacea</i> Meig.	1
<i>Nemopoda cylindrica</i> Fabr.	1
<i>Piophilina casei</i> Linn.	8
<i>Chlorops variceps</i> Loew.	1
<i>Oscinis coxendrix</i> Fitch.	2
<i>Agromyza diminuta</i> Walk.	1
<i>Desmometopa latipes</i> Meig.	1
" <i>m-nigrum</i> Zett.	1
Total, 27 species	61

COLEOPTERA (Beetles).

	Specimens
<i>Anthrenus verbasci</i> Linn.	1
<i>Adalia bipunctata</i> Linn.	1
Total, 2 species	2

HEMIPTERA (Bugs, leaf-hoppers, etc.).

	Specimens
<i>Lygus pratensis</i> Linn.	1
Undetermined Psyllid	1
Total, 2 species	2

Black Currant, *Ribes nigrum*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
<i>Apanteles</i> sp.	1	..	1
<i>Thersilochus</i> sp.	..	3	3
<i>Vespa germanica</i> Fabr.	..	1	1
<i>Agapostemon radiatus</i> Say.	..	1	1
<i>Halictus lerouxii</i> Lep.	..	2	2
" (<i>Erylaeus</i>) <i>arcuatus</i> Robt.	..	6	6
" " <i>truncatus</i> Robt.	..	19	19
" (<i>Chloralictus</i>) <i>sparsus</i> Robt.	..	81	81
" " <i>zephyrus</i> Sm.	..	9	9
" " sp.	..	2	2
" " "	..	4	4
" " <i>pilosus</i> Sm.	..	8	8
<i>Andrena vicina</i> Sm.	2	..	2
<i>Bombus consimilis</i> Cress.	..	1	1
" <i>pennsylvanicus</i> DeG.	..	1	1
Total, 15 species	3	138	141

DIPTERA (Flies, mosquitoes).

	Specimens
<i>Eristalis bastardi</i> Macq.	1
<i>Lucilia caesar</i> Linn.	3
<i>Scatophaga stercoraria</i> Linn.	2
<i>Nemopoda cylindrica</i> Fabr.	1
<i>Piophilha casei</i> Linn.	1
<i>Chlorops assimilis</i> Macq.	1
<i>Phorbia fusciceps</i> Zett.	3
Total, 7 species	12

COLEOPTERA (Beetles).

	Specimen
<i>Adalia bipunctata</i> Linn.	1
Total, 1 species	1

Wild Plum, *Prunus* sp.

HYMENOPTERA (Bees, wasps, ants).			
	Male	Female	Total No. Specimens
<i>Halictus (Erylaeus) arcuatus</i> Robt.		1	1
<i>Trachandrena crataegi</i> Robt.	1	3	4
<i>Andrena vicina</i> Sm.		1	1
" <i>salicacea</i> Robt.		1	1
" (<i>Opandrena</i>) <i>bipunctata</i> Cress.		18	18
Total, 5 species	1	24	25

DIPTERA (Flies, mosquitoes).		Specimens
<i>Ceratopogon fuscus</i> Coq.		1
Undetermined Chironomid		2
<i>Stratiomyia discalis</i> Loew.		1
<i>Odontomyia pubescens</i> Day.		1
<i>Hilaria leucoptera</i> Loew.		2
<i>Triodonta curvipes</i> Wied.		1
<i>Zodion fulvifrons</i> Say.		1
<i>Nemopoda minuta</i> Wied.		3
Total, 8 species		12

COLEOPTERA (Beetles).		Specimens
<i>Crepidodera helxinus</i> Linn.		1
<i>Attagenus piceus</i> Oliv.		1
Total, 2 species		2

Japan Plum, *Prunus triloba*.

HYMENOPTERA (Bees, wasps, ants).			
	Male	Female	Total No. Specimens
<i>Sympraxis</i> ? sp.		1	1
<i>Aphanogmus</i> ? sp.		1	1
<i>Formica fusca subsericea</i> Say.			4
<i>Ancistrocerus tigris</i> Saus.	1		1
<i>Colletes inaequalis</i> Cress.		1	1
<i>Halictus fasciatus</i> Nyl.		1	1
" <i>lerouxii</i> Lep.		1	1
" (<i>Erylaeus</i>) <i>arcuatus</i> Robt.		7	7
" " <i>truncatus</i> Robt.		5	5
" (<i>Chloralictus</i>) <i>pilosus</i> Sm.		1	1
" " <i>zephyrus</i> Sm.		1	1
" " <i>sparsus</i> Robt.		207	207
" " sp.		3	3
<i>Paralictus cephalicus</i> Robt.		1	1
<i>Trachandrena crataegi</i> Robt.	13	3	16
" <i>claytoniae</i> Robt.		1	1
" <i>forbesii</i> Robt.	1	3	4
" " var.		1	1
" sp.		1	1

HYMENOPTERA (Bees, wasps, ants)—*Cont'd.*

	Male	Female	Total No. Specimens
<i>Andrena vicina</i> Sm.	..	4	4
" <i>nasoni</i> Robt.	6	4	10
" <i>salicacea</i> Robt.	..	2	2
" (<i>Opandrena</i>) <i>bipunctata</i> Cress.	19	65	84
Total, 23 species	40	314	358

DIPTERA (Flies, mosquitoes).

	Specimens
<i>Ceratopogon fuscus</i> Coq.	1
<i>Camptocladius byssinus</i> Schr.	9
<i>Sciara</i> sp.	1
Undetermined Empid	2
<i>Platychirus hypoboreus</i> Staeg.	4
<i>Panzeria radicum</i> Fabr.	2
<i>Cynomyia cadaverina</i> Desv.	1
<i>Phormia regina</i> Meig.	1
<i>Hyetodesia lucorum</i> Fall.	1
<i>Phorbia fusciceps</i> Zett.	6
Undetermined Anthomyid	1
<i>Scatophaga stercoraria</i> Linn.	3
<i>Sepsis violacea</i> Meig.	1
<i>Nemopoda stercoraria</i> Desv. ?	1
<i>Piophilha casei</i> Linn.	7
<i>Chlorops assimilis</i> Macq.	1
Total, 16 species	42

COLEOPTERA (Beetles).

	Specimens
<i>Crepidodera helxinus</i> Linn.	1
<i>Aphodius granarius</i> Linn.	1
<i>Anthrenus scrophulariae</i> Linn.	1
<i>Xantholinus cephalus</i> Say.	1
<i>Adalia bipunctata</i> Linn.	1
Total, 5 species	5

Sweet Cherry, *Prunus avium*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
<i>Apanteles</i> sp.	..	..	1
Undetermined Cynipid	..	..	1
<i>Vespa diabolica</i> Saus.	..	1	1
<i>Colletes inaequalis</i> Cress.	..	1	1
<i>Agapostemon radiatus</i> Say.	..	2	2
<i>Halictus fasciatus</i> Nyl.	..	5	5
" <i>lerouxii</i> Lep.	..	1	1
" (<i>Evylaeus</i>) <i>arcuatus</i> Robt.	..	14	14
" " <i>truncatus</i> Robt.	..	7	7

HYMENOPTERA (Bees, wasps, ants)—*Cont'd.*

	Male	Female	Total No. Specimens
<i>Halictus (Chloroglictus) zephyrus</i> Sm.		15	15
" " <i>pilosus</i> Sm.		14	14
" " <i>sparsus</i> Robt.		185	185
" " <i>obscurus</i> Robt. ?....		1	1
" " <i>n. sp.</i>		1	1
" " <i>sp.</i>		2	2
" " "		7	7
" " "		7	7
<i>Trachandrena crataegi</i> Robt.		1	1
" <i>forbesii</i> Robt.	1	..	1
" " var.		3	3
" <i>claytoniae</i> Robt.		1	1
" <i>hippotes</i> Robt.		1	1
<i>Andrena vicina</i> Sm.	2	13	15
" <i>mandibularis</i> Robt.		3	3
" <i>nasoni</i> Robt.	12	2	14
" <i>carlini</i> Ckll.	1	1	2
" (<i>Opandrena</i>) <i>bipunctata</i> Cress.	7	40	47
<i>Bombus virginicus</i> Oliv.		1	1
<i>Apis mellifera</i> Linn.		..	5
Total, 29 species	23	329	359

DIPTERA (Flies, mosquitoes).

	Specimens
Undetermined Chironomid	1
<i>Xylota ejuncida</i> Say.	1
<i>Phorbia fusciceps</i> Zett.	2
<i>Piophilha casei</i> Linn.	3
Total, 4 species	7

COLEOPTERA (Beetles).

	Specimens
<i>Crepidodera helxinus</i> Linn.	1
<i>Epuraea labilis</i> Er.	1
<i>Carpophilus discoideus</i> Lec.	1
<i>Adalia bipunctata</i> Linn.	1
Total, 4 species	4

Peach, *Prunus persica*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
<i>Halictus (Chloralictus) versatus</i> Robt.		1	1
" " <i>n. sp.</i>		1	1
" " <i>obscurus</i> Robt.		3	3
" " <i>sparsus</i> Robt.		2	2
<i>Andrena (Opandrena) bipunctata</i> Cress.		2	2
<i>Bombus virginicus</i> Oliv.		..	1
" <i>ridingsii</i> Cress.		..	1
<i>Apis mellifera</i> Linn.		..	1
Total, 8 species	0	9	12

Apple, *Pyrus malus*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
<i>Caliroa</i> ? sp.		I	I
<i>Amblyteles</i> sp.		I	I
<i>Camponotus pennsylvanicus</i> DeG.		..	2
<i>Formica fusca subsericea</i> Say.		..	I
<i>Vespa maculata</i> Linn.		I	I
" <i>didolicus</i> Sauss.		I	I
<i>Agapostemon radiatus</i> Say.		2	2
<i>Halictus lerouxii</i> Lep.		4	4
" (<i>Chloralictus</i>) <i>zephyrus</i> Sm.		II	II
" " <i>pilosus</i> Sm.		5	5
" " <i>sparsus</i> Robt.		30	30
" " <i>obscurus</i> Robt.		I	I
" " <i>versatus</i> Robt.		6	6
" " sp.		..	3
" " "		..	4
" (<i>Evylaeus</i>) <i>truncatus</i> Robt.		I	I
<i>Andrena nasoni</i> Robt.		I	I
" <i>vicina</i> Sm.		5	5
" <i>carlini</i> Ckll.		6	6
" sp.	4	..	4
" (<i>Opandrena</i>) <i>bipunctata</i> Cress.	I	II	12
<i>Trachandrena claytoniae</i> Robt.		I	I
" <i>crataegi</i> Robt.		I	I
" <i>hippotes</i> Robt.		I	I
<i>Synhalonia atriventris</i> Sm.	I	..	I
<i>Osmia</i> (<i>Ceratosmia</i>) <i>lignaria</i> Say.		34	34
<i>Xylocopa virginica</i> Dru.	15	..	15
<i>Bombus ridingsii</i> Cress.		I	I
" <i>americanorum</i> Fabr.		I	I
" <i>consimilis</i> Cress.	5	2	7
" <i>virginicus</i> Oliv.		2	2
<i>Apis mellifera</i> Linn.		..	31
Total, 32 species	26	130	197

DIPTERA (Flies, mosquitoes).

	Specimens
<i>Ceratopogon</i> sp.	I
<i>Chironomus modestus</i> Say.	I
Undetermined Cecidomyid	I
<i>Chrysogaster pulchella</i> Will.	I
<i>Helophilus hamatus</i> Loew.	I
<i>Triodonta curvipes</i> Wied.	I
<i>Sarcophaga heliciis</i> Town.	I
<i>Lucilia caesar</i> Linn.	I
<i>Homalomyia scalaris</i> Fabr.	3

DIPTERA (Flies, mosquitoes)—*Cont'd.*

	Specimens
<i>Anthomyia radicum</i> Linn.	1
<i>Phorbia cinerella</i> Fall.	1
" <i>fusciceps</i> Zett.	4
Undetermined Anthomyid	1
<i>Scatophaga stercoraria</i> Linn.	1
<i>Lonchaea rufitarsis</i> Macq.	1
<i>Piophilha casei</i> Linn.	4
Total, 16 species	24

COLEOPTERA (Beetles).

	Specimens
<i>Telephorus bilineatus</i> Say.	2
<i>Adalia bipunctata</i> Linn.	1
<i>Bradycellus rupestris</i> Say.	4
Total, 3 species	7

HEMIPTERA (Bugs, leaf-hoppers, etc.).

	Specimen
<i>Miris affinis</i> Reut.	1

Pear, *Pyrus communis*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
<i>Nematus</i> sp.		1	1
<i>Agapostemon radiatus</i> Say.		2	2
<i>Paralictus cephalicus</i> Robt.		1	1
<i>Halictus fasciatus</i> Nyl.		1	1
" (<i>Euvlaeus</i>) <i>arcuatus</i> Robt.		1	1
" " <i>truncatus</i> Robt.		2	2
" (<i>Chloralictus</i>) <i>sparsus</i> Robt.		3	3
" " <i>n. sp.</i>		1	1
" " <i>zephyrus</i> Sm.		1	1
" " <i>sp.</i>		4	4
<i>Trachandrena crataegi</i> Robt.	3	0	3
" <i>forbesii</i> Robt.		1	1
" <i>claytoniae</i> Robt.		1	1
<i>Andrena vicina</i> Sm.		1	1
" <i>nasoni</i> Robt.	6	12	18
" <i>macgillivrayi</i> Ckll. var.		1	1
" (<i>Opandrena</i>) <i>bipunctata</i> Cress.	3	8	11
Total, 17 species	12	40	53

DIPTERA (Flies, mosquitoes).

	Specimens
Undetermined Chironomid	2
<i>Tachydromia pusilla</i> Loew.	3
<i>Platychirus hypoboreus</i> Staeg.	1
<i>Metachaeta helymus</i> Walk.	1

DIPTERA (Flies, mosquitoes)—*Cont'd.*

	Specimens
Undetermined Tachinid	1
<i>Morellia micans</i> Macq.	1
<i>Phorbia fusciceps</i> Zett.	3
<i>Piophilha casei</i> Linn.	4
<i>Chlorops assimilis</i> Macq.	1
Total, 9 species	17

COLEOPTERA (Beetles).

	Specimens
<i>Diabrotica vittata</i> Fabr.	1
<i>Anthrenus scrophulariae</i>	1
<i>verbasci</i>	1
Total, 3 species	3

Quince, *Cydonia vulgaris*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
<i>Exochus pallipes</i> Cress.		1	1
<i>Formica fusca subcericea</i> Say.		..	2
<i>Odynerus (Ancistrocerus) campestris</i> Sauss. ..		..	1
<i>Halictus lerouxii</i> Lep.		1	1
<i>fasciatus</i> Nyl.		9	9
(<i>Lasioglossum</i>) <i>coriaceum</i> Sm.		1	1
(<i>Evyllaues</i>) <i>truncatus</i> Robt.		3	3
(<i>Chloralictus</i>) <i>pilosus</i> Sm.		5	5
" <i>zephyrus</i> Sm.		2	2
" <i>tegularis</i> Robt.		6	6
" <i>sparsus</i> Robt.		18	18
" <i>obscurus</i> Robt. ?		1	1
" <i>versatus</i> Robt.		3	3
" <i>sp.</i>		1	1
<i>Andrena (Opandrena) bipunctata</i> Cress.		2	2
" <i>nasoni</i> Robt.		3	3
<i>Trachandrena crataegi</i> Robt.	1	1	2
<i>Ceratina dupla</i> Say.	1	..	1
<i>Osmia (Ceratosmia) lignaria</i> Say.		..	1
<i>Bombus virginicus</i> Oliv.		1	1
" <i>consimilis</i> Cress.		1	1
<i>Apis mellifera</i> Linn.		..	3
Total, 22 species	2	58	68

DIPTERA (Flies, mosquitoes).

	Specimens
<i>Tachydromia pusilla</i> Loew.	2
<i>Mesogramma marginata</i> Say.	1
<i>Tropidia quadrata</i> Say.	1
<i>Syrirta pipiens</i> Linn.	1
<i>Ophyra leucostoma</i> Wied.	1
<i>Nemopoda cylindrica</i> Fabr.	1
<i>Agromyza aeneiventris</i> Fall.	1
Total, 7 species	8

COLEOPTERA (Beetles).

	Specimen
<i>Diabrotica vittata</i> Fabr.	1

Common Blackberry, *Rubus nigrobaccus*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No Specimens
<i>Prenolepis imparis</i> Say.	..	..	2
<i>Halictus (Chloralictus) sp.</i>	..	1	1
<i>Trachandrena forbesii</i> var.	..	1	1
" <i>sp.</i>	1	..	1
<i>Andrena (Opandrena) bipunctata</i> Cress.	3	7	10
<i>Bombus americanorum</i> Fabr.	..	1	1
" <i>ridingsii</i> Cress.	..	..	1
<i>Apis mellifera</i> Linn.	..	..	1
Total, 8 species	4	10	18

Red Raspberry, *Rubus strigosus*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
<i>Eumenes fraterna</i> Say.	..	..	1
<i>Odynerus pennsylvanicus</i> Sauss.	..	..	1
<i>Prosopis affinis</i> Sm.	..	2	2
" <i>pygmaea</i> Cress.	..	1	1
<i>Halictus fasciatus</i> Nyl.	..	1	1
" (<i>Chloralictus</i>) <i>sparsus</i> Robt.	..	1	1
<i>Andrena sp.</i>	..	1	1
" <i>hilaris</i> Sm. ?	..	1	1
<i>Ceratina dupla</i> Say.	..	4	4
<i>Alcidamea producta</i> Cress.	1	1	2
<i>Celioxys sp.</i>	1	..	1
<i>Osmia pumila</i> Cress.	..	4	4
<i>Bombus ridingsii</i> Cress.	1	1	2
Total, 13 species	3	17	22

Strawberry, *Fragaria virginiana*.

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
<i>Formica sp.</i>	..	..	1
<i>Halictus fasciatus</i> Nyl.	..	2	2
" (<i>Chloralictus</i>) <i>versatus</i> Robt.	..	5	5
<i>Trachandrena claytoniae</i> Robt.	..	..	1
Total, 4 species	0	7	9

COLEOPTERA (Beetles).

	Specimens
<i>Crepidodera helxinus</i> Linn.	1
<i>Byturus unicolor</i> Say.	1

Total, 2 species

2

RELATIONSHIP BETWEEN THE FLOWERS AND THEIR INSECT VISITORS.

It will be noticed that the Hymenoptera are more abundant on the blossoms of these fruits than are the other orders of insects. A majority of the Hymenoptera in these collections—majority of both species and individuals—belong to the superfamily *Apoidea*, which includes the honey bee and the bumble bee. These bees are known to gather pollen and nectar for their young, and this explains their visits to the flowers. In each of the lists of hymenoptera most of the species are bees. Beginning with *Colletes*, or in some cases with *Agapostemon* and *Halictus*, all others on the lists belong to the *Apoidea*.

Just what the other insects are doing in the flowers is more uncertain. It is known that certain beetles feed upon pollen, and doubtless the flies and parasitic hymenoptera are attracted by the nectar upon which they may feed.

Let us first consider the *Hymenoptera*. It will be noticed from the foregoing list that by far the most abundant visitors to these flowers were the small bees belonging to the *Halictidae* called "sweat bees," and the *Andrenidae*. These have long been known to be important agents in the transfer of pollen.

Of the 760 specimens collected on *Ribes oxycanthoides*, 417, or more than half, were *Halictus* (*Chloralictus*) *sparsus* Robt. Other species important to the plant on account of their numbers were *Halictus fasciatus* Nyl. 26, *H. lerouxii* Lep. 30, *H. (Evylaeus) arcuatus* Robt. 19, *H. (Chloralictus) pilosus* Sm. 32, *Andrena vicina* Sm. 54, *A. nasoni* Robt. 13, and three species of *Halictus* (*Chloralictus*) which are probably new, represented respectively by 20, 31 and 14 specimens.

On the red currant we find some of the same species, but the proportions are entirely different. Here one of the new species of *Halictus* (*Chloralictus*) was the most abundant, and was represented by 13 specimens out of 58. *C. zephyrus* Sm. had 7 examples, while the other 26 species are each represented by less than 4 specimens.

Of 141 specimens taken from black currant, 81 were *Halictus* (*Chloralictus*) *sparsus* Robt., 19 *H. (Evylaeus) truncatus* Robt., 9 *H. (Chloralictus) zephyrus* Sm., 8 *H. (C.) pilosus* Sm., and 6 *H. (Evylaeus) arcuatus* Robt.

The undetermined *Prunus* was visited chiefly by *Andrena* (*Opandrena*) *bipunctata* Cress., 18 out of the 25 specimens of *Hymenoptera* being that species.

358 specimens of *Hymenoptera* were collected on *Prunus triloba*, the Japan plum, and 207, or about three-fifths, were *Halictus* (*Chloralictus*) *sparsus* Robt., 84 were *Andrena* (*Opandrena*) *bipunctata* Cress., 16 *Trachandrena crataegi* Robt., 10 *Andrena nasoni* Robt., 7 *Halictus* (*Evylaeus*) *arcuatus* Robt., and 5 *H. (E.) truncatus* Robt.

From *Prunus avium* 359 specimens of *Hymenoptera* contained 185 of *Halictus* (*Chloralictus*) *sparsus* Robt., 14 of *C. pilosus* Sm., 15 of *C. zephyrus* Sm., 14 of *Halictus* (*Evylaeus*) *arcuatus* Robt., 15 of *Andrena vicina* Sm., 14 of *A. nasoni* Robt. and 47 of *Andrena* (*Opandrena*) *bipunctata* Cress. There were also 7 specimens of each of three other species of *Halictus*, and 5 of the honey bee, *Apis mellifera* Linn.

Very few insects could be found on peach blossoms, and all that we captured belong to the *Hymenoptera*. Apparently insects do not visit the blossoms in such great numbers and swarm about the trees as is the case with apple, plum and cherry. Of the 12 specimens captured, 3 were *Halictus* (*Chloralictus*) *obscurus* Robt., and there were 2 specimens each of *H. (C.) sparsus* Robt. and *Andrena* (*Opandrena*) *bipunctata* Cress. One honey bee was taken.

Of 197 specimens collected from apple, 34 were *Osmia lignaria*, the commonest species. Honey bees were more abundant than on the other fruit flowers, 31 being taken. The next most abundant species was *Halictus* (*Chloralictus*) *sparsus* Robt., 30 specimens; *Xylocopa virginica* Dru., 15; *Andrena* (*Opandrena*) *bipunctata* Cress., 12; *Halictus* (*Chloralictus*) *zephyrus* Sm., 11; bumble bee, *Bombus consimilis* Cress., 7. Other species, making a total of 32, had each a lesser number of examples.

On pear flowers, 18 out of the 53 *Hymenoptera* specimens were *Andrena nasoni* Robt., 11 *A. (Opandrena) bipunctata* Cress., and there were not over 3 or 4 specimens of any other species. *Halictus* (*Chloralictus*) *sparsus* Robt., which was so abundant on gooseberry, Japan plum, sweet cherry and apple, was not taken at all from pear in 1904, but 3 examples were captured in 1905. No honey bees were taken.

The collection from quince flowers was made at New Haven and Branford wholly in 1905. Of 68 specimens, 18 were *Halictus* (*Chloralictus*) *sparsus* Robt., 9 were *H. fasciatus* Nyl., and of the other kinds not over 6 examples of a species were taken. This included 3 honey bees.

The 18 specimens of *Hymenoptera* from the blackberry contained a single honey bee, and 10 examples of *Andrena* (*Opandrena*) *bipunctata* Cress., which seems to be an important visitor.

The commonest insects collected from red raspberry were *Cerantina dupla* Say. and *Osmia pumila* Cress., 4 each. Not over 2 specimens each were taken of any of the other species, which were 13 in all.

From strawberry flowers 9 specimens were taken, 5 of which were *Halictus* (*Chloralictus*) *versatus* Robt., and 2 were *H. fasciatus* Nyl.

The collections from the flowers of the peach, blackberry, raspberry and strawberry are meager, and perhaps no general statements should be made regarding them. Nevertheless, they indicate the more important pollinating species for the particular localities where taken.

There is no doubt that some of the *Diptera* aid in pollinating the blossoms, for some species are so hairy that if they visit the flowers at all they are certain to carry away some pollen. Such species are *Scatophaga stercoraria* Linn., *Eristalis bastardi* Macq., *Phorbia fusciceps* Zett., and the few specimens representing the genera *Panzeria*, *Tridonta*, *Sarcophaga*, *Fucellia*, *Lucilia* and *Anthomyia*; but except the first and third, these were not sufficiently abundant to be considered as important. It is interesting to note that the commonest flies on these flowers, *Elachiptera costata* Loew., *Ceratopogon fuscus* Coq., *Chlorops assimilis* Macq., *Lonchoptera riparia* Meig. and *L. lutea* Panz., are not hairy, but smooth and shiny and not well fitted to carry pollen. The same is true of the species of *Nemapoda*, *Camptocladus*, *Tachydromia* and *Piophilila* represented in these collections. The few beetles and bugs captured are hardly worth considering as carriers of pollen.

In other localities or in other seasons, the results of such collecting might be quite different. In 1904 there were fewer

honey bees taken than in 1905, yet the small bees were effective pollinators. The trees and bushes bore a heavy crop of fruit. Rainy weather interfered somewhat with the transfer of pollen in 1905, and though the small fruits had a good crop, some of the tree fruits bore lightly.

With our knowledge of the habits of the insects collected, together with the conditions surrounding the localities where they were taken, it seems fair to assume that on account of their great numbers the small bees belonging to the *Halictidae* and the *Andrenidae* are more important agents in carrying pollen than has formerly been supposed, and in the vicinity of New Haven during the seasons of 1904 and 1905 were of far greater benefit in pollinating the flowers of the plants from which they were collected than were the honey bees.

ADDITIONAL MOSQUITO INVESTIGATIONS.

BY W. E. BRITTON AND H. L. VIERECK.

In the Report for 1904, page 253, was published an account of the investigations regarding Connecticut mosquitoes and their breeding places. This report treats of mosquito conditions over the entire salt marsh area along the coast, and of the regions about Hartford, East Hartford, Middletown and Cheshire. During 1905 very little attention was given to mosquito work, but a swamp in Milford was visited by request, and the regions about Farmington, New Britain and Rockville were examined by Mr. Viereck in August. The season of 1905 was marked by a shortage in precipitation, especially during the last half of the summer; consequently at the time of Mr. Viereck's visits to these places nearly all pools were dry, and very little mosquito breeding was found.

Milford.

Letters were received regarding the swamp adjoining and just east of the cemetery and north of the railroad. This swamp was visited by Messrs. Britton and Viereck on August 10th, and the pools of the swamp were tested. Both *Anopheles* and *Culex* larvae were found, though not very abundant. The swamp should be cleaned up and drained or filled. The

former would probably be difficult or impossible on account of the topography of the region, but as the area is small, it would not be an expensive matter to fill about the edges, leaving, perhaps, a central pond to be stocked with fish.

While around this swamp we were literally covered with salt marsh mosquitoes (*Culex sollicitans*), which came from their hiding places in the brush of the swamp. These mosquitoes do not breed here, but probably came from the large salt marsh to the south of the village. Improving the swamp near the cemetery would not, therefore, greatly reduce the numbers of mosquitoes in the village, because they come chiefly from the salt marsh. But a place of this kind so near the village and cemetery should be put in the best sanitary condition.

Farmington.

The region between the railroad station and the village was examined August 18th. This area was found nearly free from breeding places, though it comprised a marshy section extending along a primary branch of the Farmington river, and a similar area imperfectly drained by a secondary branch of the same stream. In the latter marsh, tests were made in pools on the property of Mr. A. H. Hopson and in the field adjoining on the side toward the railroad station. *Anopheles* and *Culex* larvae were taken in the last two places mentioned, as many as six *Anopheles* being found in one ladleful of water. These larvae were taken to the laboratory, but *A. punctipennis* was the only species of *Anopheles* reared from the material. For this area better drainage should be provided, and this can be done at small expense.

Though tests were made in nearly all of the suspicious pools, no mosquito larvae were found in the marsh area along the branch of the Farmington river, but as the examination was made after a period of drought, it is quite possible that under other conditions mosquito breeding might occur in this area.

New Britain.

On the eighteenth of August the region about New Britain was examined for possible mosquito-breeding places. The local health officer was consulted, and stated that no com-

plaints had been made about mosquitoes, and that the only possible breeding place of a serious character to be found in the vicinity would be the pond at the foot of Arch Street near the end of the car line. This pond is used for cutting ice in winter, and when examined consisted of little more than a mud flat with a stream running through the center. Near the stream was a small pool in the mud, but no mosquito larvae were found in it. From the appearance of this region it is probably never a serious breeding place.

Rockville.

On August 22d Mr. Viereck visited Rockville, but found not even an area that could be suspected of breeding mosquitoes. Though examined during a period of dry weather, the region seems to be well drained, and the report of the health officer for the past ten years indicates comparative freedom from malaria. The few cases that occur might easily have originated out of town.

Salt Marsh Mosquito at Middletown.

Mr. Walden captured an adult specimen of *Culex sollicitans* at Middletown, July 3d, near the summit of Round Hill. This locality is sixteen or seventeen miles from the coast as the bird flies, and this species of mosquito breeds only in the salt marshes. It is known to migrate inland in search of food, and in New Jersey goes as far as thirty miles, but we have never before taken the species in Connecticut except along the coast.

THE WOOLLY MAPLE LEAF SCALE.

Phenacoccus acericola King.

This insect was first studied at Peoria, Ill., by Miss E. A. Smith, who published an account of the species in the North American Entomologist for 1880, page 73, under the name of *Pseudococcus aceris* Geoff., supposing it to be identical with the European species. In most of the literature this insect has been recorded under that name. On further study it was found to be different from the European species, and was described and named by Mr. George B. King in 1902.*

* Canadian Entomologist, Vol. 34, p. 211.

It is now about five years since I first observed this insect on the maple street trees of New Haven, though the insect may have been present for a much longer time. It has now become quite a serious pest of the sugar maple in Connecticut towns and cities. I have seen it in many places in New Haven, Hartford, Bridgeport and South Norwalk.

On August 2d some maple leaves were sent by a New Haven seed firm with the statement that one of their customers brought them in and asked to know a remedy. The leaves came from a place on Humphrey Street, and were seriously infested with the woolly maple leaf scale. I visited the place immediately, and found a sugar maple of ten or twelve inches in trunk diameter, which was so thoroughly infested that scarcely a leaf was free from the white masses of wax. Many leaves had already dropped. The upper portion of the trunk was completely covered with the larvae. A leaf, showing larvae and waxy egg masses, and a piece of bark from the trunk, showing larvae and male pupae, all from this tree, are reproduced on Plate VII. Two other small trees near by were also infested, though less seriously.

Experiments in Destroying this Pest.

The owner feared that the trees would be killed, and wished to save them if possible. At that time I had not seen any definite advice regarding treatment, and I recommended that the trees be sprayed with ordinary kerosene emulsion. This was done on August 4th, and the mixture contained two gallons kerosene, one half pound common hard soap and one gallon of hot water as a stock solution, this being diluted nine times before using. A few days later I found that a few of the scales had been killed, but that most of them had not been injured by the spray. The owner informed me that the spraying did no good.

These trees were sprayed the second time, August 17th, using an emulsion containing more kerosene and made up with a soft naphtha soap without hot water. Two gallons kerosene, one pound soap, one gallon water, were the quantities used, the whole being diluted five times before applying. This time the trees were very thoroughly drenched, and the spray was directed against the lower sides of the leaves and upon

the bark of the trunk and branches where the larvae were gathered in the crevices. Even with this emulsion containing more kerosene, and with the naphtha soap, it was a somewhat difficult matter to moisten the egg-masses on account of the wax. The first spray striking a leaf rolls off in small drops, but if the nozzle is kept long enough in one place, the mass finally becomes soaked with the emulsion.

A few days after this treatment the trees were examined, and nearly all of the insects appeared to be dead. A few leaves only showed indications of having been injured slightly by the spray.

After making these tests, I ran across Professor Cooley's "Notes on Some Massachusetts *Coccidae*"* in which he states that in the cities of Springfield and Holyoke the authorities have found it necessary to adopt combative measures to control this insect. In Springfield the bark was scraped during the winter and treated with a concentrated whale oil soap solution applied with whitewash brushes. Although this seems to have killed most of the insects, yet at the end of the following summer they had multiplied so rapidly that the treatment was repeated the next winter.

The maples of Holyoke were sprayed with one pound of whale oil soap dissolved in one gallon of water in February, 1896, and for the next two years the insects were not sufficiently abundant to require further treatment.

Unquestionably the best remedial treatment is a winter spray of petroleum, whale oil soap, or some of the contact poisons which can be used in much more concentrated form than can be applied to the foliage. It is difficult to combat this insect with summer sprays. If kerosene emulsion contains much more than 15 per cent. of kerosene, there is danger of injuring the foliage, and if half this percentage of kerosene is employed it will not destroy the scale.

Description, Life History and Habits.

On the under sides of the leaves may be seen masses of white wax about one-fourth of an inch (6 to 7 mm.) in length and somewhat less in width (though varying greatly in size),

* Bureau of Entomology, U. S. Department of Agriculture, Bulletin 17 N. S., p. 61.

having a powdery and woolly appearance. In this mass we find the body of the living or dead female, and a large number of eggs. The adult female is light yellow in color, and is about 5 mm., or one-fifth of an inch long, bearing a number of spinnerets and short spines on the upper surface of the body. The antennae are 9-jointed, the last joint being the longest. The adult male has two wings, and is red in color.

Eggs are found throughout the waxy secretion, and are from 0.3 to 0.4 mm. in length and about half as wide, and light yellow in color.

The larvae when first hatched occupy the under surface of the leaf, though often found on both sides. The female is pale yellow, while the male larva is reddish yellow. When mature the males crawl about over the bark of the branches and trunk, and transform to pupae in the crevices of the rough bark, the adults emerging about two weeks later. The maturing females forsake the leaves and crawl about on the bark, mate with the males, and later return to the leaves and settle upon the under surface. Soon after, the secretion of white wax is commenced, and eggs are deposited in it, both forming a larger mass. Some of this wax often falls or is torn from the leaves by storms, and it adheres to anything coming in contact with it. The number of eggs ranges from 500 upward, and there are three generations each year, according to Dr. L. O. Howard,* who has published one of the most comprehensive accounts of this insect, from which I have gleaned many of the facts set forth in this paper.

At the approach of winter the larvae go to the bark of the branches and trunk, where they line the crevices with their waxy secretion, and remain therein during the winter, crawling about on warm days. They are usually most abundant on the upper portion of the trunk and around the base of the larger branches. The woolly egg-masses and male cocoons are shown on Plate VII.

Natural Enemies.

From material collected, we bred a number of Syrphid flies, and even found some of the larvae feeding upon the scales. Specimens of the adults were submitted to Mr. C. W.

* *Insect Life*, Vol. VII, p. 235, 1894.

Johnson, of the Boston Society of Natural History, who is a specialist in the *Diptera*, and were identified as *Baccha fascipennis* Wied. This fly is a slender species, with dark bands across the wings. It was sufficiently abundant to warrant us in believing it an important natural enemy of the scale.

The fly, however, was parasitized, and some of the pupae did not yield adult flies, but gave tiny hymenopterous parasites belonging to the genus *Terastichus*. Dr. Howard states that *Baccha fascipennis* Wied. was bred from material sent to him from Jamaica Plains, Mass., and that a species of *Pachyneuron* was reared from the puparium. Three species of lady beetles, *Hyperaspis signata*, *Anatis 15-punctata* and the twice-stabbed lady beetle, are recorded as feeding upon the woolly maple leaf scale in Illinois, and the first was found feeding on the scales received by the Bureau of Entomology from Massachusetts.* All three of these lady beetles occur in Connecticut.

THE WHITE-MARKED TUSSOCK MOTH.

Hemerocampa (Orgyia) leucostigma S. & A.

One of the serious defoliators of shade trees in towns and cities is the white-marked tussock moth, an insect which has done considerable damage during the year of 1905. Early in July I noticed a horsechestnut tree on Elm Street, New Haven, near the corner of York Street, which was being defoliated by the caterpillars, and I sent my assistant to collect material. Mr. Amrhyh, Superintendent of Parks, called upon us to examine an infested tree in Bay View Park, which Mr. Walden did on July 20th. A single chestnut had been wholly stripped of leaves by the caterpillars. The same day elm trees on Orange Street near the corner of Bradley Street were examined by Mr. Walden, attention having been called to these trees by Mr. Frank S. Platt. A large number of cocoons were present on the trunks and larger branches of the trees, and from most of these the moths had emerged. The females were laying eggs, and many white egg-masses could be seen. A photograph of one of the trees with egg-masses on the trunk is shown on Plate VIII. On July 26th, I was called to Hartford to look at some infested trees, and a similar state of affairs was

* Insect Life, Vol. VII, p. 235, 1894.

found. Large elm and poplar trees on North Main Street near the railroad tunnel were so attacked that they had been partially defoliated, and the trunks were literally covered with the cocoons and egg-masses. Egg-masses and cocoons were also received by mail from Hartford.

Later we saw evidences of the work of the insect through the eastern part of the city of New Haven, especially in Grand Avenue and State Street, where a number of elms had been defoliated. The authorities put men at work destroying the egg-masses on some of the worst infested trees along the city streets.

Life History and Habits.

There are two broods each year in Connecticut, and the insect passes the winter in the egg stage. The eggs hatch in May, and the young caterpillars begin to feed upon the under side of the leaves, eating at first only the green portion, and leaving the framework. As the caterpillars increase in size, they eat holes through the leaves, and when nearly full-grown are voracious feeders and devour the whole leaf except perhaps the largest veins. The larval stage lasts about five weeks, during which time the caterpillars molt or cast their skins five times. When nearly mature, the caterpillars have the habit of crawling considerable distances, and are able to go over the ground from one tree to another. Where numerous, they migrate from the defoliated trees, and may be seen crawling over fences, sidewalks or vehicles, and in this way other trees having no egg-masses become attacked.

The larva is very striking and handsome in appearance, of yellow color beneath, with grey stripes along the sides, and a black dorsal stripe between two narrow yellow ones. Along the sides on the grey and yellow stripes are a number of yellow tubercles, each bearing white hairs. Four tufts of white hair are borne on the back of the anterior end of the body, while on the posterior portion in the middle of the black dorsal stripe are two bright red tubercles without hairs. Head and dorsal front portion of first segment are bright coral red. On each side of the head is a pencil or tuft of long black hairs, and a larger tuft occurs on the posterior extremity. The legs and pro-legs are yellow.

The mature larva spins its cocoons about the first week in July, and with the silken threads mixes some of the long hairs of its own body, forming a grey cocoon, which is usually placed on the rough bark of the trunk or larger branches, though sometimes on the small twigs or leaves. The insect



FIG. 1.—White-marked Tussock Moth. *a*, larva; *b*, female pupa; *c*, male pupa; *d*, *e*, male moth; *f*, female moth; *g*, female laying eggs; *h*, egg-mass; *i*, *k*, cocoons—all slightly enlarged. (After Howard, Bur. of Ent., U. S. Dept. of Agr.)

remains in the cocoon nearly two weeks, and as has already been mentioned in this paper, adults had emerged and many egg-masses had been laid on July 20th. The female is without wings, and greatly resembles the females of the canker worms though larger. She is about one-half or five-eighths of an inch long, and grey in color, and usually lays the egg-masses (containing from 75 to 200 eggs) on the empty cocoons. We often see the females hanging in this position on the old

cocoons and egg-masses long after they are dead. The male is a greyish brown moth having feathered antennae, and a wing expanse of about an inch. The adults, caterpillars, cocoons and egg-masses are shown in figure 1, and on Plates VIII and IX.

The eggs laid in July soon hatched, and we fed the caterpillars through August and into September, when they became full-grown and pupated, and adults emerged from some of the cocoons.

Poplars, elms, and soft maples seem to be the trees commonly attacked and injured, but the insect is known to feed upon nearly all kinds of fruit trees, and most of the forest and shade trees except conifers.

Remedies.

There are two chief methods of controlling this insect; (1) by poisoning the foliage, and (2) by destroying the eggs. For spraying, arsenate of lead (about 3 lbs. in 50 gallons of water) is probably the best poison to be used, and it should be sprayed upon the leaves in June in order to destroy the larvae of the first brood. As this poison adheres well to the foliage, it may not be necessary to make more than one thorough application.

The destruction of the eggs is perhaps the most economical method of fighting the pest, and this can be accomplished in two ways: (1) by scraping off and burning the egg-masses, or (2) by treating them on the tree with something that will prevent their hatching. The former method is practiced in New York and some other large cities, where men are employed for the purpose, and become very expert in the use of a specially made tool, consisting of a small hoe blade mounted on the end of a long pole. By means of this tool many of the egg-masses can be reached from the ground and dislodged. If left upon the ground or not destroyed, the eggs will hatch, and they should be burned or treated with creosote oil or something that will prevent hatching. Kirkland advises the use of crude creosote oil for destroying the eggs. A sponge on the end of a long pole is dipped in the liquid and placed against the egg-masses. The oil is rather dark colored, and the white egg-masses are sufficiently discolored by it to show where treated. This was first used for killing gypsy moth

eggs, which are yellowish brown in color, and 15 per cent. of coal tar was added to the oil to color the eggs so that the treated ones could be distinguished from those not treated.

Banding the trunks of unattacked trees will prevent the caterpillars from crawling up, but is of little use if eggs, larvae, or pupae are already in the tree.

THE MORE IMPORTANT COCCIDAE OR SCALE-INSECTS OF CONNECTICUT.*

The terms "scale," "scale-insect" and "bark-louse" are commonly used to designate insects belonging to the family Coccidae of the order Homoptera. The Homoptera are often included in the Hemiptera, to which belong the true bugs, aphids or plant-lice, and leaf-hoppers. These insects all suck their food, and many of them cause serious injury to cultivated plants. The Hemiptera have incomplete transformations, and the Coccidae are probably the most degraded of the Hemiptera. The males are said to have complete transformations, but possess only two wings in the adult state. Soon after birth the young crawl about for a few hours; otherwise the females are without means of locomotion except in a few species, and are attached to the bark or foliage of trees and plants, from which they suck out the sap for food. Some of our worst pests are scale-insects. The object of this paper is to illustrate and describe briefly the more important kinds occurring in Connecticut, so that people will be able to recognize them more readily and combat them more successfully.

As some of these insects secrete a substance which forms a shell or covering for protection, they are called armored scales. Other kinds not forming shells are known as unarmored or soft scales. Most of the unarmored scales secrete honey dew like the plant-lice.

The Latin names and arrangement of the following species are the same as given in Mrs. Fernald's Catalogue of the Coccidae of the World. The illustrations (Plates II-VI) are all original, and show the insects natural size except where otherwise indicated. Plate III, d, is from a drawing. All others are from photographs.

* A part of this paper was published in June as Bulletin 151. With some additions and changes it is here reproduced in different form.

UNARMORED OR SOFT SCALES.

1. **THE GREENHOUSE ORTHEZIA**—*Orthezia insignis* Dougl.

This insect is not fixed, but crawls about like the mealy bugs, and is shown on Plate II, c. Full-grown specimens are about 1.5 mm long. It attacks a great variety of greenhouse plants, Lantana and Coleus being favorites. The treatment used against mealy bugs, page 236, is advised against this insect. All breed continuously in greenhouses, and there are probably many generations each year.

2. **PIT-MAKING OAK SCALE**—*Asterolecanium variolosum* Ratz.

This scale is circular, usually greenish-yellow in color, and has a glassy appearance. It forms a pit or depression in the bark where it is situated, and it is about 2 mm in diameter. (See Plate III, a.) This species has been sent to the Station several times on English oak, *Quercus robur*, though it is known to attack other oaks. Kerosene emulsion and whale oil soap have been used as a spray with good results in destroying this insect.

3. **OAK GALL SCALE**—*Kermes galliformis* Riley.

A globular gall-like scale found on oak twigs. It is grey, about as high as long, and slightly broader than its length, which is about one-fourth of an inch. There is a longitudinal dorsal furrow or constriction. Shown on Plate VI, b.

4. *Kermes andrei* King.

Slightly smaller than the preceding, without constriction, light brown, shiny, with three or four dark brown transverse bands. This scale is also found on oak, but is not very common.

5. **ELM SCALE**—*Gossyparia spuria* Modeer.

A dark-colored oval scale margined by a white cottony fringe is not uncommon upon elm trees about New Haven. It seems to prefer small trees, but is sometimes found on the lower branches of medium-sized and large trees. The insect

is about 3 mm long, brown or black surrounded by a fringe of white wax, and is shown on Plate III, c. The young are born alive, appearing about the middle of June in Connecticut, and settle along the veins of the leaves chiefly on the under sides. Later in the season they return to the larger branches and trunk, and occupy the crevices of the bark, where they remain through the winter. There is but one brood each year. Honey dew is given off profusely by the nearly mature females, and often drips upon the ground. The scales are readily destroyed at any time of the year by spraying with kerosene emulsion or soap and water.

6. WOOLLY MAPLE LEAF SCALE—*Phenacoccus acericola*
King.

White powdery masses of wax 6 or 7 mm long are frequently seen on the under side of leaves of the sugar maple. The waxy mass contains the mature female (often dead) and a large number of eggs. This insect is shown on Plate VII, and a full account of it is given on page 226 of this report.

7. COMMON MEALY BUG—*Pseudococcus citri* Risso.

The mealy bug is a common pest of plants in greenhouses and dwellings and even out of doors in summer. Unlike most scales, the mealy bugs are not fixed to their food plants, but are able to move about, and they attack nearly all kinds of plants. The full-grown females are about 4 mm long and oval in shape. They are creamy or dirty white, and covered with a wax secretion which gives them a mealy appearance. They usually congregate in the crotches and at the axils of the leaves so as to be somewhat protected. The illustration, Plate II, d, shows them gathered along the mid-vein of a leaf. Spraying with soap and water or fir tree oil or dipping the plants in the mixture is the remedy, but hydrocyanic acid gas fumigation is doubtless the most satisfactory for greenhouses.

8. LONG SPINED MEALY BUG—*Pseudococcus longispinus*
Targ.

Resembles the preceding, except that the adults bear filamentous appendages at the posterior end of the body. The species is well distributed.

9. COTTONY MAPLE SCALE—*Pulvinaria innumerabilis* Rathv.

This scale can be recognized during early summer by the large white egg-masses on the twigs. Nearly all maples as well as many other trees are attacked, but the insect seems to prefer the silver maple. It is not as yet a very serious pest in Connecticut, but in Chicago, Denver, and some other Western cities the maples are being seriously injured by it, and extensive spraying is practiced. There is one annual brood, with eggs laid in May and June, which hatch in July and August. The young first settles on the leaves. The males appear in early fall and mate with the females, which migrate to the twigs, where they remain through the winter. In the spring they increase rapidly in size, and soon deposit their egg-masses and shrivel and die. The brown female with white egg-mass protruding posteriorly is about 12 mm ($\frac{1}{2}$ inch) long, and is shown on Plate III, d. The species is abundantly attacked by insect parasites.

Kerosene emulsion is used as a remedy.

A closely allied species, *P. acericola* Walsh & Riley, is reported from New York and Massachusetts, and doubtless occurs here, but the writer has not observed it. It seems to be confined almost exclusively to the silver maple, and the egg-masses are laid on the leaves instead of the twigs. This requires two migrations,—from the leaves to the twigs in fall, and from twigs to the new leaves in spring. The females with egg-masses are about $\frac{1}{2}$ inch long, the egg-mass tapering backward, with four longitudinal ridges.

10. SOFT SCALE—*Coccus hesperidum* Linn.

Much has been written about this scale, which was formerly placed in the genus *Lecanium*. It is an oval, slightly convex brown species commonly found on citrus trees, oleanders and many other plants in greenhouses. Females are viviparous, but the generations are not well marked. Soap and water or kerosene emulsion will readily destroy these scales at any season of the year.

11. APRICOT SCALE—*Eulecanium armeniacum* Craw.

During recent years this species has become common out of doors in Connecticut, and a wide range of plants are attacked.

We have observed it on plum, grape, chestnut, ash and rose. It is oval in shape, about 4 mm long, strongly convex, and light or dark brown in color. Plate IV, d, gives a good idea of its appearance. This scale is sufficiently abundant to cause considerable injury, and remedial measures must be taken against it. There is one brood annually, the eggs hatch about July 1st, and the scale winters in a partially grown condition. Spraying in winter with kerosene emulsion has been successful, but where orchards are treated with lime and sulphur washes for the San José scale, no other treatment need be given.

12. *Eulecanium canadense* Ckll.

A brown scale on elm twigs, collected in New Haven, June 10th, 1905, by Mr. Walden, proved to be this species. Externally it resembles *E. armeniacum*, and doubtless the same remedy will control it.

13. NEW YORK PLUM SCALE—*Eulecanium cerasifex* Fitch.

Plum twigs thoroughly infested with this scale were received from Berlin in 1904. Superficially it looks like *E. armeniacum*, which is shown on Plate IV, d. The writer has made no observations regarding its life history. Where it occurs the same treatment advised for *armeniacum* should be employed.

14. *Eulecanium kingii* Ckll.

A few specimens on sassafras were identified as this species by Mr. Geo. B. King. In appearance it closely resembles the three preceding species.

15. TERRAPIN SCALE—*Eulecanium nigrofasciatum* Perg.

The writer has several times collected this scale from the twigs of silver maple, a favorite food plant, which the scale often injures, though it is known to infest fruit and other trees. The females are smaller than in any other species of the genus mentioned in this paper. The adult female is of a reddish color spotted with dark red or black, 2 mm long, convex, with about twelve radiating ridges, most conspicuous near the margin. There is probably one brood each year, eggs being formed in May and hatching in July. (See Plate IV, e.)

16. TULIP SCALE—*Eulecanium tulipiferae* Cook.

This scale is becoming quite common on wild and cultivated tulip trees throughout the state. It is the largest of all the brown scales, the hemispherical females often reaching a diameter of 8 mm, or $\frac{1}{3}$ of an inch. The male scales are much smaller and more elongated. The light grey pupa skins remain on the bark after the adult males have emerged. Both sexes are shown on Plate IV, f. Apparently there is but one brood each year, the viviparous females producing young about September 1st. They are partially grown when winter sets in. As a rule the lower branches are first attacked, and often killed, when those next higher will in turn become infested. Linden and magnolia are also attacked by this scale. Kerosene emulsion, and soap and water applied in the form of a spray, in autumn, are the common remedies.

17. FERN SCALE—*Saissetia filicum* Bdv.

A large brown scale resembling the hemispherical scale, but slightly shorter and more convex, and much less common. It has been an inhabitant of the Station greenhouses, where it seems to prefer the holly shield fern, *Cyrtomium falcatum*.

18. HEMISPHERICAL SCALE—*Saissetia hemisphaerica* Targ.

This is probably the most common of all the large brown scales found in greenhouses and dwellings. It has a long list of food plants, and may be expected to attack almost any kind of plant, but chiefly palms, ferns, *Cycas* and orchids. It is from 3 to 4 mm long, and reddish or dark brown in color. Specimens are found on both leaves and stems. (See Plate III, b.) It probably breeds continuously throughout the year.

Kerosene emulsion, fir tree oil and soap and water can be used as sprays and greenhouses can be fumigated with hydrocyanic acid gas to destroy this insect.

ARMORED SCALES.**19. WHITE ELM SCALE**—*Chionaspis americana* Johnson.

This scale, which attacks the twigs of the elm, closely resembles the scurfy scale, shown on Plate IV, c. It is not very abundant in Connecticut.

20. *Chionaspis corni* Cooley.

The females are pear-shaped, males are small and with sides parallel. Both sexes are white, and closely resemble the scurfy scale, to which the species is closely related. It occurs commonly on wild dogwood, *Cornus candidissima*. The life history is probably similar to that of the scurfy scale.

21. **EUONYMUS SCALE**—*Chionaspis euonymi* Comst.

This species was recently sent to the writer from Hartford, where it was abundant on *Euonymus radicans* along a brick wall. The wall was covered with canvas, and the plants fumigated with hydrocyanic gas.

The euonymus scale resembles the scurfy scale, but the females are somewhat smaller and darker in color. It passes the winter in the egg stage, and the different species of *Euonymus* and the orange are attacked. It is shown on Plate II, b.

22. **SCURFY SCALE**—*Chionaspis furfura* Fitch.

The female shell is broadly pyriform, 3 mm in length, and white or light grey. See Plate IV, c. The male is much smaller, white, with sides parallel, and three ridges along the back. A single brood is formed each year, and the winter is passed in the egg stage. These eggs are oval in shape, purple in color, and hatch between May 20th and June 1st. Spraying with soap and water or kerosene emulsion soon after the eggs hatch will readily destroy the young. For a more complete history of this insect the reader is referred to Bulletin No. 143, or the Report of this Station for 1903, page 227.

23. **PINE LEAF SCALE**—*Chionaspis pinifoliae* Fitch.

Resembles the preceding, but is attached to the leaves or "needles" of the pine, spruce and other coniferous trees. It has been collected at South Manchester on *Pinus mughus* and at Hartford on white pine. There are two broods each year, and the winter is passed in the egg stage. See Plate II, c.

24. *Diaspis boisduvalii* Sign.

This scale, found on palms and various greenhouse plants, resembles the rose scale. The female is large, nearly circular,

with the exuvium not in the center. The male is long and narrow, and both sexes are nearly white.

25. **ROSE SCALE**—*Aulacaspis rosae* Bouché.

A large white scale is sometimes seen on rosebushes, raspberry or blackberry canes, especially where growing in crowded rows or clumps. The female is nearly circular, 2.5 mm in diameter, and is shown on Plate V, a. The male is much smaller, long and narrow, with three parallel ridges running lengthwise of the shell. Professor John B. Smith of New Jersey finds that all stages from the egg to the mature female occur at the same time during the winter and throughout the season. Probably there are but three complete broods, but these overlap so that breeding is almost continuous.

As all stages of the insect occur at the same time remedial treatment is somewhat difficult, as the eggs are usually not killed by sprays, and sometimes survive even fumigation. The worst infested canes should be cut out and burned. Kerosene emulsion or soap and water should be used as a summer spray, and the lime and sulphur mixture may be applied to the dormant plants in winter.

26. *Epidaspis piricola* Del Guer.

A circular scale occurring under the edges of rough bark and covered with extraneous matter so as to be very inconspicuous. Found on pear twigs from New London.

27. **HEMLOCK LEAF SCALE**—*Aspidiotus abietis* Schr.

This species was found on hemlock at Norwalk. It is a small circular or elongated brown scale, and is sometimes found upon pine or fir.

28. **PUTNAM'S SCALE**—*Aspidiotus ancylus* Putnam.

This is a small circular scale, 2 mm in diameter, which occurs throughout the state on fruit trees, but perhaps most frequently upon currants, often killing the second year canes or shoots. The shells of this scale are usually not as nearly circular as the San José scale, but it is often difficult to distinguish them in the field. Apparently there is but one brood each year.

29. *Aspidiotus cyanophylli* Sign.

This is a small light colored circular scale often found infesting palms and orchids in greenhouses. Specimens in the Station collection were taken at New Haven, January 9th, 1904.

30. **CHERRY SCALE**—*Aspidiotus forbesi* Johnson.

This scale closely resembles the preceding, and though not so widely distributed, has been found upon fruit trees in Connecticut. It should be regarded as a serious enemy, and treated in the same way as the San José scale.

31. **WHITE SCALE; OLEANDER SCALE**—*Aspidiotus hederæ* Vall.

This scale is a pest of greenhouses, where it attacks oleander, croton, ivy, palms, camellia and many other plants. It is nearly circular in shape, and white or light grey in color, making it conspicuous on the green leaves and stems. (See Plate II, a.) It probably breeds continuously in greenhouses. Fumigating the house with hydrocyanic acid gas, spraying the infested plants with either whale oil or common soap (1 lb. in 8 gallons of water) are the remedies for this scale.

32. **EUROPEAN FRUIT SCALE**—*Aspidiotus ostraeformis* Curtis.

This scale is not known to be established in Connecticut, but will doubtless become so, as it has been found on nursery trees sent into the state. It looks very much like the cherry, Putnam's, and San José scales, and can be distinguished from them only by means of the compound microscope. In fact these four species resemble each other so closely that the fruit grower cannot distinguish between them unless he is an entomologist. The European fruit scale attacks all kinds of orchard trees, and there is probably a single brood each year.

33. **SAN JOSE SCALE**—*Aspidiotus perniciosus* Comst.

This is a circular scale, light or dark grey in color, with concentric markings and a nipple in the center, which is usually darker in color than the surrounding portion of the shell. The winter is passed in a half-grown condition, and there are no

eggs. The breeding season begins soon after June 20 and ends about December 1 in Connecticut, three or four broods appearing in a season. For a full account of its life history and spread, see Bulletin No. 135 of this Station.

This scale is the worst pest of the fruit grower in Connecticut, and attacks all kinds of fruit trees, except the sour cherry (*Prunus cerasus*), and many kinds of shade trees and ornamental shrubs are attacked and sometimes killed. A list of trees and plants, showing their susceptibility to attack by this scale, was published in the Report of this Station for 1902, page 130. A thorough spraying in the fall after the leaves drop, or in the spring just before the buds start, using a lime and sulphur mixture, seems to be the best remedy for Connecticut. This mixture is usually prepared by boiling together 20 pounds quicklime and 14 pounds sulphur for 45 to 60 minutes in enough water to keep it a liquid. After boiling, water should be added to make 40 gallons, and the whole applied at once. Satisfactory mixtures can be made without boiling by using potassium or sodium sulphide, caustic soda or sal soda to aid in dissolving the sulphur. Some of these mixtures and the proper outfit for spraying are described in Bulletin No. 146, and reproduced in the Report of this Station for 1904, pages 240-252.

The illustration of the San José scale on Plate IV, a, will serve to show the appearance of the other kinds which so closely resemble it. All can be combated in the same way, viz: by spraying the dormant orchard trees with the lime and sulphur mixture, and by fumigating nursery stock with hydrocyanic acid gas.

34. **ELM ASPIDIOTUS**—*Aspidiotus ulmi* Johnson.

This is a small circular scale resembling the preceding, which is found on the smooth or inner bark in the crevices of the rough bark of the trunks and larger branches of elm trees. It seems to do very little damage, but may be found on most of the elm trees of New Haven, and doubtless occurs throughout the state.

35. **CIRCULAR SCALE: FIG SCALE**—*Chrysomphalus aonidum* Linn. (*figus* Ash.).

Rubber plant, orange, palms, camellias and oleander in greenhouses are often infested by a round dark-colored scale

which, stands out prominently from the surface of the leaves. In fact it is almost conical in shape, reddish brown or nearly black, with an orange apex, and is shown on Plate V, b. Presumably it continues to breed throughout the year under glass, and continued spraying is necessary to keep it in check.

36. **RED ORANGE SCALE**—*Chrysomphalus aurantii* Mask.

A light grey or brown circular scale about 2 mm in diameter occurring on oranges and lemons in the markets and sometimes infesting citrus trees and palms in greenhouses. The scale is somewhat translucent, showing the reddish insect beneath. The female is reniform in shape. This scale causes much injury in the orange groves of California, and also occurs in Florida.

37. **MORGAN'S SCALE**—*Chrysomphalus dictyospermi* Morg.

This species is a serious pest of palms at Pierson's large commercial greenhouses, Cromwell, and it has also been taken in private plant houses in other parts of the state. It is of about the same color as the preceding species, but is flatter, and projects only slightly from the leaf. Mr. H. E. Hodgkiss studied this scale at the Massachusetts Agricultural College, and found that several generations are produced each year, but these overlap so as to become indistinct. The females bring forth living young, are parthenogenetic, and males are unknown. Fumigating the house with hydrocyanic acid gas, using 7.5 grams potassium cyanide for each 100 cubic feet of space, for forty minutes, after dark, with the plants free from moisture, is the treatment advised by Mr. Hodgkiss after making many experiments. It is probably a safe remedy for nearly all of the greenhouse scales. This species is shown on Plate VI, a.

38. **PURPLE SCALE**—*Lepidosaphes beckii* Newn.
(formerly known as *Mytilaspis citricola* Packard).

An elongated scale very commonly noticed on oranges and lemons in the markets. It has been sent to the station by correspondents, who took it to be the San José scale. It resembles the oyster shell scale, to which it is closely related, and is said to be one of the commonest orange scales in Florida. It is also found in California.

39. **OYSTER SHELL SCALE**—*Lepidosaphes ulmi* Linn.
(formerly *Mytilaspis pomorum* Bouché).

One of the most common and widely distributed of all coccids. It is a pest of fruit trees, especially apple, and many young sprouts and seedlings of birch, poplar, willow, ash and butternut are killed by it each year. Lilac is also infested. There is but one brood annually, and the insect winters in the form of oval white eggs under the female shells. The eggs hatch in Connecticut about the first of June, the young crawl for a few hours, then settle upon the bark and form shells, becoming mature in September. Eggs are laid about the first of October, and the females die. The female scale (or shell), is from 2 to 3 mm long, about the same color as the bark upon which it rests, elongated pyriform in shape, and more or less curved. It is shown on Plate IV, b. Male shells are much smaller and less curved than those of the female. The adult male has two wings, and is seldom seen. Spraying with kerosene emulsion or soap and water soon after the eggs hatch will hold this scale in check. For a more complete account see Bulletin 143, or the Report of this Station for 1903, page 229.

40. **THREAD SCALE**—*Ischnaspis longirostris* Sign.

This is a long narrow black scale attacking palms, pandanus and many other plants in greenhouses. It has been taken in Connecticut only at one greenhouse in New Haven, where it was quite abundant. Little is known of its life history, and the male is unknown. The female shell is from 2 to 3 mm long, and about eight times as long as broad, and more or less curved. (See Plate V, c.) The writer has had no experience in combating this scale, but the same treatment used for other greenhouse scales will doubtless hold it in check.

41. **CHAFF SCALE**—*Parlatoria pergandii* Comst.

This is common on various greenhouse plants, especially orange and lemon. It is oval in shape, with the molted skin at one end, and is light yellow in color. It is usually found in clusters. The common sprays used for greenhouse scales seem to be effective against this species.

THE GYPSY MOTH IN CONNECTICUT.

Ever since the gypsy moth became prevalent in Massachusetts it has seemed probable that the pest might at any time invade Connecticut. We have therefore been on the watch for it, though no systematic inspection has been made of the regions where the pest would be most liable to occur. Several times during the past five years reports of the presence in Connecticut of the gypsy moth or the brown tail moth have been brought to my attention, but investigation proved that some other insect was the cause of alarm in each case.

In compiling a list of Connecticut insects during the winter, I have corresponded with local collectors whose names appear in the Entomologists' Directory, in order to obtain records of their captures. On February 27th I received a letter from Mr. Ernst Frensch of Mystic, a collector of Lepidoptera, with records of some of the rarer species which he had taken, and this list included *Porthetria dispar* Linn., the gypsy moth. Mr. Frensch closed his letter with this sentence;—"Probably it will be new to you that *Porthetria dispar* has reached the town of Stonington."

I wrote at once, making an appointment with Mr. Frensch, and visited him at his home Tuesday, March 6th. He showed me a female which he had found on an apple tree in the yard of his brother, Karl Frensch, near the railroad, and not far from the velvet mill in Stonington. This specimen was taken July 30th, 1905, and is now in the Station collection. The attention of Mr. Frensch was first attracted by two males flying about in the tree, but as he did not have a net he could not catch them. On looking closer he found the female resting on the bark, and he put her in his cyanide jar. I was shown an egg-mass on the under side at the base of a large branch of a Norway maple growing in the yard. This was removed, and later put in a cyanide bottle to kill the eggs. Mr. Frensch also showed me an egg-mass which he found on a small twig in the brush-covered area close to the velvet mill. He suspected these to be gypsy moth eggs, but to make sure, he cut off the body of the female moth, and obtaining the eggs therein, compared them with those on the twig, and found them identical in size, shape and general appearance.

Mr. Karl Frensch also collected one female gypsy moth during the summer, and this was still in his cyanide jar at the time of my visit. The Frensch brothers have both collected insects, and Ernst has a good collection of butterflies and moths. He recognized the gypsy moth because he had been familiar with it in Germany.

On March 11th I again visited the place in company with my assistant, Mr. B. H. Walden, and we looked about the trees in the yard where the specimens were taken, but found no more fresh egg-masses. I found an old egg-mass on a pear tree in the adjoining yard. The eggs undoubtedly hatched last spring, and may have been the source of the entire infestation. I had telephoned on my arrival to Col. James F. Brown of North Stonington, Secretary of the State Board of Agriculture, and he joined us in the afternoon. In company with Mr. Karl Frensch we examined the brush-covered area just north of and close by the velvet mill. Here we found seven fresh egg-masses, which were immediately placed in cyanide bottles to kill the eggs. Rain and lack of time prevented an inspection of the whole area. As we passed through the streets of the village we watched for egg-masses on the trunks of the trees. Tussock moth eggs were abundant, but we did not see any gypsy moth eggs.

At the time of writing this report, the infested region seems to be a small one, restricted to the immediate vicinity of the velvet mill, but is being examined by a trained inspector who has had a long experience in this work in Massachusetts. Every effort will be made to stamp out the pest, and this may be possible if the insect has not already spread over a large area.

Outbreak and Distribution.

An outbreak of the gypsy moth in Eastern Massachusetts was met by an appropriation by the Legislature of that state for the purpose of suppressing the insect. Exterminative work was commenced in 1890 and kept up for ten years, when it was discontinued. During this period over \$1,000,000 was expended and the insect was so far checked that it was doing little damage in 1900. In 1905 the pest had spread over so much territory and had become so troublesome that the commonwealth again took the matter in hand, and is endeavoring

to control the insect under the superintendence of Mr. A. H. Kirkland, an appropriation of \$300,000 being available to carry on the work until May, 1907.

At the present time the insect is found throughout the eastern portion of Massachusetts, southeastern New Hampshire, and a region in and about Providence, R. I., is known to have been infested for two years or more. It has recently been found in Stonington, Connecticut.

Life History and Injury.

The eggs are laid usually on the trunks and branches of trees, but sometimes on fences, buildings, etc., in July and August, in oval masses each containing about 500 eggs and covered with hair as shown in Figure 2 and on Plate X.



FIG. 2. Egg-mass of Gypsy moth on bark, natural size.

The eggs hatch about May 1st, and the young caterpillars soon begin to feed upon the expanding foliage, devouring all kinds of vegetation, even defoliating coniferous trees. All the damage is done in this stage. As the caterpillars approach maturity, they feed mostly at night, and seek shelter during the day on the shady side of the trunks, under fence rails, stones and rubbish, where they may often be found in large numbers.

When full-grown, the caterpillar is between two and three inches long, dark brown, with a pair of blue spots on each of the first five segments, and the same number of red spots on

each of the other six segments, making two rows of spots along the back; it is covered with long hairs, as is shown in Figure 3. The caterpillar usually reaches full size in July, and transforms to a pupa or chrysalis, usually spinning a few threads about itself, and is shown in Figure 4 and on Plate X.

During the latter half of July the adult moths emerge, mate, and the females lay eggs. The brown male has a wing expanse of one and one-half inches, and flies about in the daytime in



FIG. 3. Gypsy caterpillar,
natural size.



FIG. 4. Chrysalis or pupa
of Gypsy moth. Natural size.

a zigzag course. The female has a heavy body, and does not fly far, though furnished with wings which expand about two inches, and which are nearly white, with delicate black markings. See Figure 5. The male is shown in Figure 6. There is but one brood each season.

Means of Distribution.

As the caterpillars crawl about in going from one tree to another, they are very apt to invade freight cars on the siding, and be carried to other places. When young they have the habit of spinning down on slender threads from their food, trees, and may thus drop on carriages, automobiles or railroad

cars, and be carried long distances into a part of the country heretofore uninfested.

Natural Enemies.

There are several species of parasitic Hymenoptera, Diptera and predaceous insects that attack both the gypsy and brown-tail moths in Massachusetts, and they are also devoured by birds, toads, and other insectivorous animals. But all of these working together do not control the pests.

Importation of Parasites.

In Europe, the native home of these insects, there are a larger number of parasitic enemies belonging to species not



FIG. 5. Female Gypsy moth, natural size.

found in this country. During 1905, Dr. L. O. Howard, the Government Entomologist, in coöperation with the Massachusetts authorities, collected in Europe some of the parasites of the gypsy and brown-tail moths, and sent them to Massachusetts, where they will be reared and finally distributed in the infested region. Of course these parasites may not be able to thrive, or even to live, in this country, but it is an experiment worth trying, and we certainly hope for much benefit from it.

Remedial Measures.

One of the most effective means of controlling the gypsy moth is by destroying the egg-masses on the trunks and branches of trees, on fences, stones, or wherever they occur. A sponge, brush or swab is dipped in creosote mixture, and the egg-masses are saturated with it. A long pole can be

used to reach the egg-masses, but it is often necessary for men to climb about in the trees in order to reach them. Where brush land is badly infested, it is often best to cut and burn the brush between August and May to destroy the eggs. Spraying the foliage with arsenate of lead, using 5 pounds to 50 gallons of water, will of course save the trees from injury for the season. This poison adheres to the tree for a long time, and will not injure the leaves. Paris green can be used at the rate of one pound in 100 gallons of water, but two pounds of lime should be added to prevent injury to the foliage. This mixture will not adhere to the leaves as well as arsenate of lead.

The caterpillars can be gathered and destroyed while resting on the tree trunks or hiding under rubbish during the day. The chrysalids or pupae will be found in similar places, and can also be destroyed by heat or by crushing.



FIG. 6. Male Gypsy moth, natural size.

Coöperation Desired.

It is earnestly requested that any suspected eggs, caterpillars or adults be called to the attention of the State Entomologist, in order that he may identify them. He will investigate any locality suspected of being infested with either the gypsy or brown-tail moths, and every possible means will be taken to eradicate them if found. This is a matter so serious as to be exceedingly important, and the coöperation of every one is needed and desired.

DO NOT SEND LIVING INSECTS.

It is against the United States laws to send living insects by mail, and violations of the law are punishable by a heavy fine and imprisonment. Moreover it would be dangerous to send such pests as the gypsy or brown-tail moths in any stage of their existence, if alive.

All insect specimens should therefore be killed before sending them to be identified.

Eggs, pupæ and larvæ can be killed by dropping them into a jar of alcohol, benzine or gasoline and leaving them for a few hours. When removed the liquid evaporates and they are in good shape for identification. Beetles, bugs and scale insects can be treated in the same way. Moths and butterflies may be killed by the fumes of cyanide, chloroform, ether, carbon bisulphide, or they may be submerged in gasoline or benzine, which kills them quickly without injuring them for the purpose of identification. They should be packed in a tin, wood or strong paste-board box which will not be crushed in transit.

RAVAGES OF THE INDIAN MEAL MOTH IN A SEED WAREHOUSE.

In November I learned that one of the large seed warehouses of Connecticut was infested with some insect that was causing considerable damage to corn, peas, lettuce and other seeds stored there. The place was visited November 17th, and the Indian meal moth, *Plodia interpunctella* Hubn., was found to be responsible for most of the damage. A few larvae of the cadelle, *Tenebroides mauritanicus* Linn., were also present, feeding in the bags of corn.

The seeds had been cleaned and stored in bags, and corn was more seriously infested than other seeds. Larvae were very abundant on the outside of some of the bags, where they had made a covering of their webs, which could be peeled off in large sheets. One of these webs with larvae is shown on Plate XI, b. The kernels of corn next to the bag were infested as shown in the illustration on Plate XI, a, but these were fastened to the bag by the web so that on emptying a bag several pounds of corn adhered to the bag. Some larvae were found in the center of the bag, but most of them were near the outside.

One room, partitioned off in the storehouse, seemed to be fairly tight, measured 16 × 30 feet and 9 feet high and contained 4,320 cubic feet. Some of the worst infested bags of corn were moved into this room, which was fumigated with hydrocyanic acid gas. Materials used were as follows:

Potassium cyanide	2¾ lbs.	
Sulphuric acid	5½ "	
Water	11 "	(5½ qts.)

The acid was placed in a stone china wash bowl, and properly diluted with the water. About 5 P. M. the cyanide was added and the room closed and remained so until November 20th, when it was opened up and aired. At first the owner thought that all of the larvae were dead. After a few hours, however, larvae were crawling about on the outside of the bags, having emerged from within, where the gas did not reach them. The webs on the outside of the bags doubtless prevented the gas from penetrating the bags, though it is doubtful if this gas would penetrate the grain to any great distance if the webs were absent.

The Indian meal moth is often a pest of dwellings, stores and warehouses, feeding upon all kinds of vegetable foods and products, and breeding throughout the year in heated

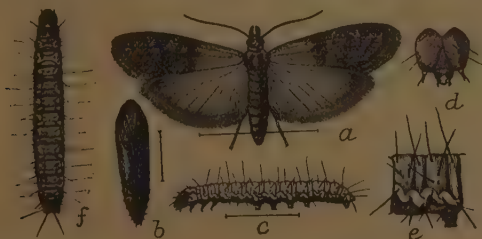


FIG. 7. Indian meal moth. *a*, adult; *b*, pupa; *c*, larva, side view; *d*, head of larva, front view; *e*, first abdominal segment of larva; *f*, larva, dorsal view—all greatly enlarged. (After Chittenden, Bur. of Ent., U. S. Dept. of Agriculture.)

buildings. From four to five weeks are required for the production of a brood. The eggs are small and white, and are laid in groups, each group containing from three to twelve eggs. As many as 350 may be laid by a single female. The caterpillars as they feed and travel spin a silken thread joining together the particles of food and their excrement. This habit renders worthless considerable material which, though infested, has not been devoured by them. They transform to chrysalids in small silken cocoon-like webs, and from these the adult moths emerge. The moth is light brown, with the outer half of each front wing dark brown. It has a wing-spread of from one-half to three-fourths of an inch. It is closely related to the common clothes moth, which it resembles except

that it is much darker in color. The larva, pupa and adult are shown in Figure 7.

The best and cheapest remedial treatment is to place the loose seeds or grain in a tight bin and fumigate with carbon bisulphide, using about one pound of the liquid for each one hundred bushels, and placing it in a shallow dish on the top of the grain. It vaporizes quickly, and being a heavy gas, penetrates readily to the bottom of the bin. No fire should be brought where bisulphide is used, for the vapor is very explosive.

IDENTIFICATION OF INSECTS.

The identification of insects for correspondents, fruit growers, farmers, and others, is increasing each year, and considerable time is required for this work. In addition to the regular work of this sort, the entomologist's office has rendered aid in determining species collected in Branford by Rev. H. W. Winkley. Mr. Winkley has taken an interest in collecting insects, and has furnished us much valuable material for our collection. He is now preparing a local collection of species found in Branford, to be placed in the beautiful library in that village, and we in turn have helped him to classify his specimens.

Aside from Mr. Winkley's material, 174 samples have been received for identification during the year. For the determination of some of the species I am indebted to the Bureau of Entomology at Washington. A classified list of those which could be determined is here given.

INSECTS RECEIVED FOR IDENTIFICATION DURING 1905.

ORTHOPTERA.		
<i>Ischnoptera pennsylvanica</i> DeG.	Cockroach	Mt. Carmel.
<i>Spharagemon scutellæ</i> Morse.		Mt. Carmel.
<i>Scudderia curvicauda</i> DeG.		Hartford.
<i>Ceuthophilus grandis</i> Scudd.	Camel Cricket	Mt. Carmel.
HEMIPTERA.		
<i>Hematompinus vituli</i> Linn.	Long-nosed ox louse.	Lower Canada.
<i>Cicada canicularis</i> Harr.		New Haven.
<i>Euchenopa binetala</i> Sav.		Middletown.
<i>Phylloxera vastatrix</i> Planch.	Grape phylloxera	Noroton.
<i>Chermaphis abietis</i> Linn.	Spruce gall louse	New Haven.
<i>Pemphigus acerfolii</i> Riley.		Hartford.
<i>Schizoneura americana</i> Riley		Hartford.
<i>Schizoneura pinicola</i> Thos.		Middletown.
<i>Schizoneura</i> sp.		Greenwich.
<i>Lachnus strobi</i> (?) Fitch		Waterbury.
<i>Callipterus betulae</i> Fitch		Hartford.
<i>Aphis gossypii</i> Glover (?)		Suffield.
<i>Aphis pomi</i> DeG.	3 samples	Farmington, Middletown, Guilford.
<i>Myzus rosarum</i> Walker (?)		Simsbury.
<i>Nectarophora rudbeckiæ</i> Fitch.		Concord, Mass.
<i>Aleyrodes vaporariorum</i> Westw.	White fly, 2 samples	New Haven, Hartford.
<i>Orthesia insignis</i> Dougl.	The greenhouse orthesia	Hartford.
<i>Asterolecanium pustulosum</i> Ckll.		Nicaragua.
<i>Lecaniodiaspis rugosus</i> Hemp. (?)		Nicaragua.
<i>Phenacoccus acercola</i> King.	Woolly maple leaf scale, 3 samples	New Haven, Westport.
<i>Pulvinaria innumerabilis</i> Rathv.	Cottony maple scale	Norwich.
<i>Pulvinaria</i> sp.		Black Hall.
<i>Eulecanium</i> probably <i>armentum</i> Craw.	Apricot scale, 3 samples	New Haven, Stamford.
<i>Eulecanium nigrofasciatum</i> Perg.	Terrapin scale	Forestville.
<i>Eulecanium tulipiferae</i> Cook.		Columbia.

INSECTS RECEIVED FOR IDENTIFICATION DURING 1905—Continued.

<i>Chionaspis euonymi</i> Comst.	Euonymus scale	Hartford.
<i>Chionaspis furfura</i> Fitch	Scurfy scale, 11 samples	From Woodbridge, Danbury, Brooklyn, Enfield, Newington, South Coventry, Montowese, New Haven, Norfolk, Meriden, Clinton.
<i>Chionaspis pinifoliae</i> Fitch	Pine leaf scale	Hartford.
<i>Aulacaspis rosae</i>	Rose scale, 2 samples	From Yalesville, Simsbury.
<i>Aspidiotus hederæ</i> Vallot	White, or oleander scale	Hartford.
<i>Aspidiotus perniciosus</i> Comst.	San José scale, 31 samples	From New Haven, Greenwich, Farmington, Rockville, Branford, Woodbridge, Hartford, Stamford, Seymour, Danbury, North Stonington; West Dover, Ohio; Bridgeport, Lyme, Montowese, Meriden, Union City, Southport.
<i>Lepidosaphes ulmi</i> Linn.	Oyster shell scale, 11 samples	From Lyme, Woodbridge, Branford, Guilford, Danbury, North Sterling, New Haven, Montowese, Bethlehem.
<i>Euschistus variolarius</i> Beauv.	Rose scale, 2 samples	Southington.
<i>Lophidea confusus</i> Say.		New Haven.
<i>Calacoris rapidosus</i> Say.		Bridgeport.
<i>Lygus pratensis</i> Linn.	Tarnished plant bug	Bridgeport.
<i>Poecilocapsus lineatus</i> Fab.	Four-lined leaf bug	Westport.
<i>Belostomatia americana</i> Leidy	2 samples	New Haven, Greenwich.
NEUROPTERA.		
<i>Corydalus cornutus</i> Linn.	Hellgrammite	Canada.
<i>Chrysopa oculata</i> Say.	Lace wing	Bridgeport.
<i>Colobopteris exilis</i> Hagen.		Savin Rock.
LEPIDOPTERA.		
<i>Tinocla bisceiliella</i> Hummel.	Clothes moth	New Haven.
<i>Lithocolletes hamadryella</i> Clem.	Oak leaf miner	Hartford.
<i>Bucculatrix pini-foliella</i> Clem.	Apple bucculatrix	Meriden.
<i>Plodia interpunctella</i> Hubn.	Indian meal moth	Canaan.

INSECTS RECEIVED FOR IDENTIFICATION DURING 1905—Continued.

<i>Prionoxystus robiniae</i> Peck	Carpenter worm	South Manchester.
<i>Phobetrion pillicum</i> S. & A.	Hag moth	New Haven.
<i>Sibine stimulea</i> Clem.	Saddle-back caterpillar	Bridgeport.
<i>Homocampa leucostigma</i> S. & A.	White-marked tussock moth	Hartford.
<i>Schizura concinna</i> S. & A.	Red-humped caterpillar	Hartford.
<i>Dalana integerrima</i> G. & R.	Walnut caterpillar	Middletown.
<i>Dalana ministrata</i> Drury	Yellow-necked caterpillar	New Haven.
<i>Melalopha inclusa</i> Hubn.		New Haven.
<i>Apanteles torrefacta</i> S. & A.		Greenwich.
<i>Tarache crastrioides</i> Guen.		New Haven.
<i>Euthisanotia</i> sp (?)		Bridgeport.
<i>Papaipema nitida</i> Guen.	Stalk borer	Boston, Mass.
<i>Heliothila pseudargyria</i> Guen.	False army worm	Branford.
<i>Manestra picta</i> Hart.	Zebra caterpillar, 2 samples	New Haven.
<i>Diacrisia virginica</i> Fabr.	Virgin moth	Whigville, New Haven.
<i>Hyphantria cunea</i> Dru.	Fall webworm	New Haven.
<i>Epantheria difforata</i> Fabr.	Great leopard moth	Hartford.
<i>Anisota senaloria</i> S. & A.	Senator moth; Orange-striped oak worm	New Haven.
<i>Telusa polyphemus</i> Cram.	American silk worm, 2 samples	New Haven, Hartford.
<i>Samia cecropia</i> Linn.	Cecropia moth, 2 samples	Westville.
<i>Ceratomia undulosa</i> Walk.		West Hartford, Bridgeport
<i>Vanessa antiope</i> Linn.	Mourning cloak butterfly; spiny elm caterpillar	Hartford.
		Phoenixville.
DIPTERA.		
<i>Chironomus</i> sp.		New Haven.
<i>Lastoptera vilis</i> O. S.		New Haven.
<i>Tabanus atratus</i> Forst.	Black horse fly	Hartford.
SIPHONAPTERA.		
<i>Pulex serraticeps</i>	Cat and dog flea	Oakville.

INSECTS RECEIVED FOR IDENTIFICATION DURING 1905—*Concluded.*

COLEOPTERA.		
<i>Scolytus rugulosus</i> Ratz.	Fruit bark beetle	Wilton.
<i>Xyleborus caelatus</i> Eich.		North Carolina.
<i>Pissodes strobi</i> Peck	White pine weevil	New Haven.
<i>Epicauta vittata</i> Fabr.	Striped blister beetle	Shelton.
<i>Coprosyela aurichalcea</i> Fabr.	Gold beetle	Boston, Mass.
<i>Epitrix cucumeris</i> Harr.	Cucumber flea beetle	Bridgeport.
<i>Galerucella luteola</i> Müll.	Elm leaf beetle	New Haven.
<i>Saperda candida</i> Fabr.	Round-headed apple borer	Yalesville.
<i>Prionus laticollis</i> Dru.	Broad-necked Prionus	New Haven.
<i>Orthosoma brunneum</i> Forst.	Lesser Prionus	South Manchester.
<i>Parandra brunnea</i> Fabr.		South Manchester.
<i>Osmoderma scabra</i> Beauv.		Hartford.
<i>Lachnosterna fraterna</i> Harr.	June beetle	Hartford.
<i>Macroductylus subspinosus</i> Fabr.	Rose chafer	Westport.
<i>Lasioderma testaceum</i> Dufis.	Cigarette beetle, 2 samples	New Haven.
<i>Phengodis laticollis</i> Lec. (?)		Salem.
<i>Byturus unicolor</i> Say.		Mystic.
<i>Chilacorus bicubiterus</i> Muls.	Twice-stabbed lady beetle, 3 samples	Farmington, South Coventry, Waterbury.
<i>Adalia bipunctata</i> Linn.	Two-spotted lady beetle	Westville.
<i>Acerophorus americana</i> Oliv.		Hartford.
<i>Pterostichus lucublandus</i> Say.		Newington.
HYMENOPTERA.		
<i>Emphytrus canadensis</i> Kby.	Violet saw fly	Westville.
<i>Harpiphorus maculatus</i> Norton.	Strawberry saw fly	Cromwell.
<i>Ericampoides cerasi</i> Peck	Cherry saw fly	Hartford.
<i>Camponotus pennsylvanicus</i> DcGeer	Carpenter ant.	West Cromwell.
<i>Vespa crabro</i> Linn.	European giant hornet	New Haven.

NOTES.

Rose Chafer Injuring Peaches. The common rose chafer, *Macrodactylus subspinosus* Fabr., was very abundant in June, and attacked various kinds of plants. On June 16th, some young peaches about one-third grown were received from Norwich with the statement that they were injured by the rose chafer. Some of the fruits had holes eaten into them, and others were perhaps half eaten up, and are shown on Plate XII, b. The correspondent wrote that in some cases he saw "five or six of the beetles eating at one opening with heads close together, and with bodies radiating out from this comparatively small hole." He was afraid that the crop would be entirely ruined, and had the beetles picked by hand and dropped into a pail of hot water. Nearly two hundred were gathered from about forty trees.

In my own garden, rose chafers were very troublesome on peony blossoms, many fine flowers being spoiled soon after they opened. The beetles devour the petals, and on the white varieties they were more serious than on pink or red flowers because their work was more apparent, as they ate a portion of each flower and soiled the remaining portion, thus spoiling it. My only remedy was to keep a tomato can partially filled with kerosene in the garden, and whenever I saw a beetle on a flower I caught him and dropped him into the kerosene. This is a good way to manage with aster beetles in a small garden.

Lily of the Valley Attacked by a Beetle. On May 15th we noticed that the leaves of lily of the valley plants growing in the garden had been eaten in a peculiar manner. Notches had been eaten into the edges of the leaves, as is shown on Plate VI, d. A number of curculionid beetles were captured while at work on the leaves, and there is no doubt that they were responsible for the injury. Some plants were placed in the insectary, where the beetles continued to feed upon them. Through the kindness of Dr. L. O. Howard, this insect was identified at the Bureau of Entomology as *Hormorus undulatus* Uhler, and it is shown on Plate VI, c.

The Thistle Butterfly an Enemy of Hollyhocks. While inspecting the Elm City Nursery, September 8th, some larvae were noticed devouring the leaves of seedling hollyhocks growing in the nursery. A number of plants had lost nearly all of their leaves. Specimens were collected and taken to the laboratory, and some of these pupated on the 11th. On September 27th two butterflies had emerged. The thistle butterfly, *Vanessa cardui* Linn., is a common species in Connecticut.

Apple Maggot Infesting Huckleberries. During August, 1904, Mr. Walden found huckleberries with maggots in them from which adults were reared that proved to be the apple maggot fly, *Rhagoletis (Trypeta) pomonella* Walsh.

Privet Injured by Lilac Borer. A section of privet stem containing a borer was received from the Elm City Nursery Company during the summer. The stem was eaten partly off, and the larva had eaten along in the pith. From the material was reared a Sesiid moth which is known as the lilac borer, *Podosesia syringae* Harr. The injured stem and the adult insect with pupa case are shown on Plate XII, a. This species also attacks ash, mountain ash and pear.

Arsenate of Lead as a Dip for Plants. In the early summer tobacco plants were attacked by cutworms, and some fields had to be reset or perhaps planted over several times on account of their depredations. Some of the plants were cut off near the ground, but many were injured by having the leaves devoured. Some of the growers applied Paris green to the leaves in order to prevent injury. It occurred to me that at least some of the damage might be prevented by dipping the plants in arsenate of lead after they had been dug and before they were set in the field. Dipping the small plants is a very easy method of poisoning them, and is much more effective than any application of poison immediately after they are set in the field. At first we dipped the tops only, fearing injury if the roots were dipped, but a few were dipped roots and all, and no damage could be detected. On June 19th, 175 tobacco plants were set at Poquonock with the following treatment:

50 plants, tops dipped: $\frac{3}{4}$ oz. lead arsenate in 1 gal. water.
50 plants, tops dipped: $\frac{3}{8}$ oz. lead arsenate in 1 gal. water.
25 plants, tops and roots dipped: $\frac{3}{8}$ oz. lead arsenate in 1 gal. water.
50 plants, untreated.

No injury to these plants could be detected either from the effect of the treatment or by leaf-eating insects.

On June 23d tobacco plants set on the Station grounds were treated as follows:

25 plants, dipped tops: $1\frac{1}{2}$ oz. lead arsenate in 1 gal. water.
20 plants, dipped tops and roots: $1\frac{1}{2}$ oz. lead arsenate in 1 gal. water.
25 plants, dipped tops: $\frac{3}{4}$ oz. lead arsenate in 1 gal. water.
20 plants, untreated.

These plants were afterwards examined, and in no case did the poison cause the slightest injury to the plants. At Poquonock, on account of soil and location, those plants whose roots were dipped made the best growth and were the largest of all when examined on July 26th. Cutworms ceased their depredations about the time of the application, so that nothing was learned regarding the effectiveness of this treatment against them. Flea beetles caused considerable damage by eating the leaves of the untreated plants soon after setting, but the poisoned plants were absolutely free from this injury.

Tests of "American Disinfectant" as an Insecticide. A sample of this material was brought to the Station, and as claims were made for it as having considerable value as an insecticide in the Southern States, we were able to test it on a few plants. In all cases it was mixed with water in fifty per cent. strength, as recommended by the agent. The applications were made June 9th, with the following results:

Apple—dipped—tender leaves and shoots killed. *Aphis sorbi* Kalt. on the leaves were all killed.

Sweet Cherry—dipped—leaves somewhat injured. Not infested.

Rose—dipped—leaves and shoots badly injured. Aphids all killed.

Willow—sprayed—no leaves injured. Only a small proportion of young oyster shell scales were killed.

On account of the injury to foliage, this material cannot be used safely in the proportions recommended.

A Rare Neuropteroid Insect. On February 24th, 1905, I received from Mr. H. J. Goodman of Westville a specimen which he had collected in July, 1904, at Savin Rock, West Haven, which is in the town of Orange. We were able to identify this as *Colobopterus excisus* Hagen., though not in our collection. A photograph was sent to Mr. Nathan Banks, of Washington, D. C., who is a specialist in this group of insects, and he confirmed our determination. We believe this to be the first record of the occurrence of this insect in Connecticut. One specimen is recorded from New Jersey, and it has been taken at Woods Hole, Mass. Mr. Banks writes that it is a rare but widely distributed species.



a. Small boiler used by Mr. W. N. Dunham, Southington.



b. Portable steam engine boiler, showing method of drawing water from a well by means of an ejector. Outfit of Mr. E. Rogers, Southington.

OUTFITS FOR MAKING THE LIME-SULPHUR MIXTURE.



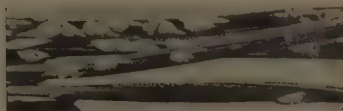
a. White or oleander scale on croton leaf.



b. *Euonymus* scale on *Euonymus radicans*. The white shells are males. A few larger grey females are present.



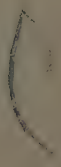
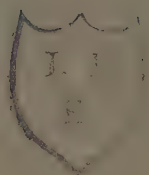
d. Common mealy bug on oleander.

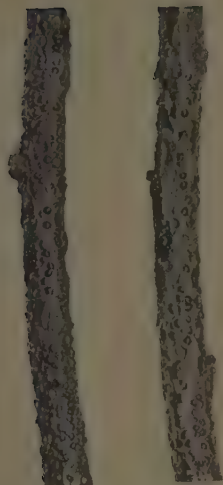


c. Pine leaf scale. Enlarged about twice.



e. The greenhouse orthezia on lantana leaf. Twice natural size.





a. Pit-making oak scale.



b. Hemispherical scale on fern.



c. Elm scale.



d. Cottony maple scale; females and egg-masses.



a. San José scale on peach twig.
Twice natural size.



b. Oyster shell scale on
poplar.



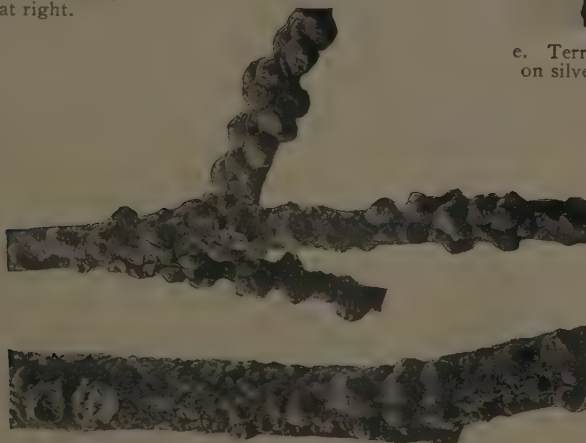
c. Scurfy scale on
currant; males at left,
females at right.



d. Apricot scale on plum;
immature scales at left, old
shells at right.



e. Terrapin scale
on silver maple.



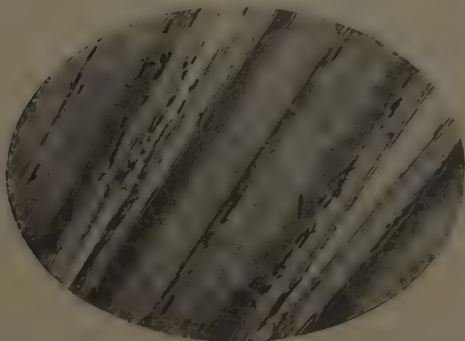
f. Tulip scale on tulip tree. Large females are shown above,
and small male shells on lower twig.



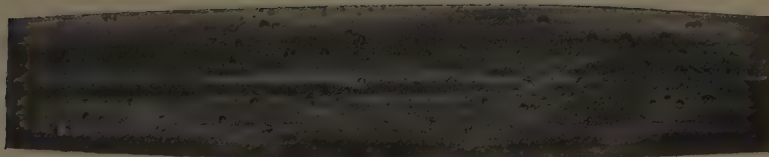
a. Rose scale: twice enlarged.



b. Circular or fig scale on rubber plant.



c. Thread scale on palm leaf.



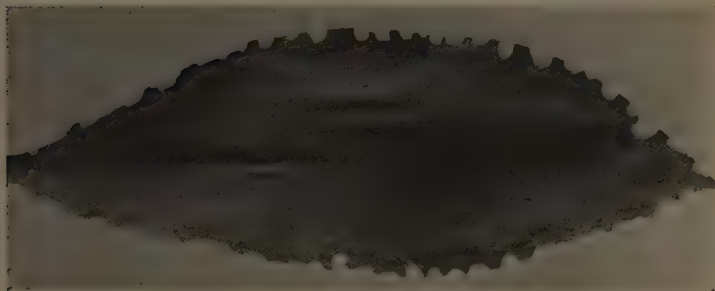
a. Morgan's scale, different stages on palm.



b. Oak gall scale.



c. *Hormorus undulatus* Uhler.



d. Lily of the valley leaf eaten by *Hormorus undulatus* Uhler.



Woolly Maple Leaf Scale. Females with egg-masses and young on leaf.
Male cocoons on bark.





White-marked Tussock Moth. Cocoons and egg-masses.



PLATE IX.



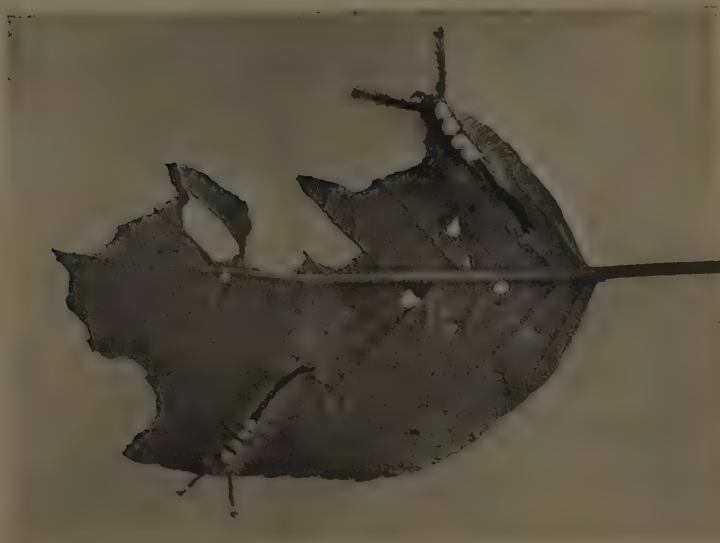
a. Egg-masses.



b. Male moth.



c. Female moth and egg-masses.



d. Caterpillars feeding on apple leaf.

WHITE-MARKED TUSOCK MOTH.



a. Female and male gypsy moths, natural size.



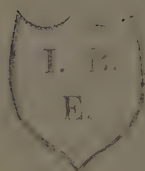
b. Pupæ,
both sexes,
natural size.

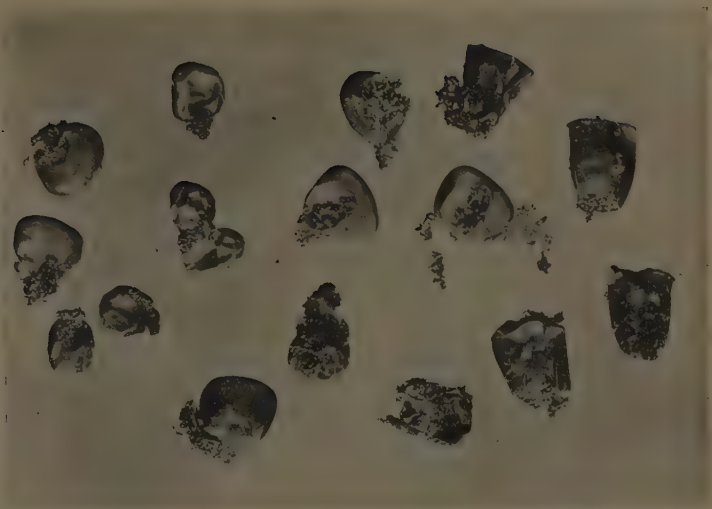
c. Caterpillars,
natural size.



d. Egg-masses,
natural size.

THE GYPSY MOTH IN ALL ITS STAGES.





a. Infested kernels of corn.



b. Larvæ and web peeled from outside of bag.
THE INDIAN MEAL MOTH.



a. Adult and pupa of lilac borer and its injury to privet.



b. Peaches eaten by the rose chafer.

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